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**FINAL**



## **Site Inspection Report**

**Vint Hill Farms Station  
Warrenton, Virginia**

**Prepared for:**

**U.S. ARMY ENVIRONMENTAL CENTER  
ABERDEEN PROVING GROUND, MARYLAND 21010**

**Prepared by:**

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13. ABSTRACT (Maximum 200 words)  A Site Inspection (SI) Report was prepared for Vint Hill Farms Station (VHFS) in Warrenton, Virginia. VHFS is a 701-acre facility located 30 miles west of Washington, D.C. The Installation was used by a variety of tenants to research, develop, produce, and sustain new signals warfare technology for military intelligence. In March 1993, VHFS was selected for closure by the Base Realignment and Closure (BRAC) Commission.  The SI was conducted between September 1994 and June 1995 at 27 areas requiring environmental evaluation (AREEs). The objective of the sampling program was to investigate the presence or absence of contamination and the chemical nature of any detected contamination at the AREEs. Inspection activities included geophysical surveys, test pit excavation, sewerline video surveys, soil organic vapor surveys, groundwater well installation, wipe sampling, and a streamlined risk assessment. Based on results from the SI program, no future action is recommended and the EPA has not requested further characterization at three AREEs. Future action is recommended and/or the EPA has requested further characterization at the remaining 24 AREEs.				
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**VINT HILL FARMS STATION  
WARRENTON, VIRGINIA**

**FINAL**

**Submitted to:**

**U.S. Army Environmental Center  
SFIM-AEC-BCB  
Aberdeen Proving Ground, Maryland 21010-5401**

**Submitted by:**

**Science Applications International Corporation  
1710 Goodridge Drive  
McLean, Virginia 22102**

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## LIST OF ACRONYMS AND ABBREVIATIONS

AAFES	Army, Air Force Exchange Service
ACIC	Aeronautical Chart and Information Center
AMC	U.S. Army Materiel Command
APCB	Air Pollution Control Board
ARAR	Applicable or Relevant and Appropriate Requirement
AREE	Area Requiring Environmental Evaluation
AST	Aboveground Storage Tank
ASTM	American Society for Testing and Materials
AWQC	Ambient Water Quality Criteria
BLS	Below Land Surface
BOD	Biological Oxygen Demand
BRAC	Base Realignment and Closure
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
C	Celsius
CARC	Chemical Agent Resistant Coating
CECOM	Communications-Electronics Command
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
CL6CP	Hexachlorocyclopentadiene
COC	Chain-of-Custody
COD	Chemical Oxygen Demand
COPC	Chemical of Potential Concern
CRL	Certified Reporting Limit
CSF	Cancer Slope Factor
CTE	Central Tendency Exposure
DCL	DataChem Laboratories
DIA	Defense Intelligence Agency
DOD	U.S. Department of Defense
DQO	Data Quality Objective



**LIST OF ACRONYMS AND ABBREVIATIONS**  
**(continued)**

DRMO	Defense Reutilization and Marketing Office
ECD	Electron Capture Detector
EM	Electromagnetic
ENPA	Enhanced Preliminary Assessment
EPA	U.S. Environmental Protection Agency
EPIC	Environmental Photographic Interpretation Center
ER-L	Effects Range-Low
ER-M	Effects Range-Median
ESE	Environmental Science and Engineering, Inc.
eV	Electron Volt
FHU	Family Housing Unit
FID	Flame Ionization Detector
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
GFAA	Graphite Furnace Atomic Absorption
gpd	Gallons per Day
gpm	Gallons per Minute
GPS	Global Positioning System
GT	Greater Than
HARN	High Accuracy Reference Network
HASP	Health and Safety Plan
HI	Hazard Index
HPLC	High-Performance Liquid Chromatography
HQ	Hazard Quotient
HRGC	High Resolution GC
IC	Ion Chromatography
ICAP	Inductively Coupled Argon Plasma
ID	Inside Diameter
IDW	Investigation-derived Waste

## LIST OF ACRONYMS AND ABBREVIATIONS (continued)

IEWD	Intelligence and Electronics Warfare Directorate
IMMC	Intelligence Materiel Management Center
IRCC	Installation Restoration Control Chart
IRDMIS	Installation Restoration Data Management Information System
IRIS	Integrated Risk Information System
LCL	Lower Control Limit
LCS	Laboratory Control Sample
LRMS	Low Resolution MS
LT	Less Than
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MCP	2-(4-Chloro-2-methyl-phenoxy)propanoic
MDL	Method Detection Limit
MEK	Methyl Ethyl Ketone
mmhos/m	Millimhos per Meter
MSDS	Material Safety Data Sheet
msl	Mean Sea Level
MS/MSD	Matrix Spike/Matrix Spike Duplicate
mS/m	MilliSiemens per Meter
mV	Millivolts
NAD	North America Data
NFA	No Further Action
NGS	National Geodetic Survey
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
nT	NanoTeslas
NTAM	Non-USATHAMA
OCDD	Octachlorodibenzo-p-dioxin
OD	Outside Diameter

**LIST OF ACRONYMS AND ABBREVIATIONS**  
(continued)

OVA	Organic Vapor Analyzer
OVM	Organic Vapor Monitor
PAH	Polycyclic Aromatic Hydrocarbons
PARCC	Precision, Accuracy, Representativeness, Comparability, and Completeness
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
PCP	Pentachlorophenol
PID	Photoionization Detector
ppb	Parts per Billion
p,p'-DDT	Pesticide 2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane
ppm	Parts per Million
ppt	Parts per Thousand
PRI	Potomac Research Institute
psi	Pounds per Square Inch
psig	Pounds per Square Inch Gauge
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act
redox	Reduction Oxidation
RfD	Reference Dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
RPD	Relative Percent Difference
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
SDWA	Safe Drinking Water Act
SI	Site Inspection

## LIST OF ACRONYMS AND ABBREVIATIONS (continued)

SOP	Standard Operating Procedure
SOV	Soil Organic Vapor
SPCS	State Planar Coordinate System
SQG	Small Quantity Generator
STP	Sewage Treatment Plant
s.u.	Standard Units
SVOC	Semivolatile Organic Compound
SWCB	State Water Control Board
TAL	Target Analyte List
TBC	To Be Considered
2,3,7,8-TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
TCE	Trichloroethene
TCL	Target Compound List
TCLP	Toxicity Characteristics Leaching Procedure
TD	Total Depth
TOC	Top of Casing
toc	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
UCL	Upper Control Limit
USAEC	U.S. Army Environmental Center
USAEHA	U.S. Army Environmental Hygiene Agency
USAF	U.S. Air Force
USATHAMA	U.S. Army Toxic and Hazardous Material Agency
USCS	Unified Soil Classification System
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
UST	Underground Storage Tank
UTL	Upper Tolerance Limit

**LIST OF ACRONYMS AND ABBREVIATIONS**  
(continued)

UV	Ultraviolet
UXO	Unexploded Ordnance
VDEQ	Virginia Department of Environmental Quality
VDWM	Virginia Department of Waste Management
VHFS	Vint Hill Farms Station
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
VPDES	Virginia Pollutant Discharge Elimination System
WLI	Water Level Indicator

## EXECUTIVE SUMMARY

This Site Inspection (SI) Report summarizes work performed by Science Applications International Corporation (SAIC) between September 1994 and June 1995 at 27 areas requiring environmental evaluation (AREEs) at Vint Hill Farms Station (VHFS). This work was conducted for the U. S. Army Environmental Center (USAEC) located at Aberdeen Proving Ground, Maryland. VHFS is located near Warrenton, Virginia and is used by a variety of tenants to research, develop, produce, and sustain new signals warfare technology for military intelligence. In March 1993, VHFS was selected for closure by the Base Realignment and Closure Commission.

The objective of the SI sampling program was to investigate the presence or absence of contamination and the chemical nature of any detected contamination at 27 AREEs. The SI did not include delineation of the areal extent of detected contamination or a detailed geologic/hydrogeologic site characterization. Sampling locations were, in general, biased toward the most probable areas of contamination. Inspection activities conducted by SAIC at VHFS included geophysical surveys, test pit excavation, sewerline video survey, field screening, soil organic vapor (SOV) surveys, subsurface borings, soil sampling, sediment sampling, groundwater probe installation, groundwater well installation, groundwater sampling, surface water sampling, wipe sampling, and topographic surveying.

A streamlined risk assessment was conducted for 12 AREEs at VHFS to support the no further action (NFA) decisions. In accordance with VDEQ guidance (VDEQ 1995), the streamlined risk assessment used the maximum detected concentration at each AREE as the exposure point concentration and evaluated exposures from soil and groundwater ingestion under both current and future land uses. Under current land use, station workers and construction workers were the receptors at risk of exposure. Under future land use, residents (children and adults) were the receptors at risk of exposure.

Based on results from the SI program, no future action is recommended and the U.S. Environmental Protection Agency (EPA) has not requested further characterization at the following three AREEs:

- Electrical Equipment Facility Pretreatment Tank (AREE 7)
- Incinerator (AREE 20)
- Transformer Storage Area (AREE 24).

No further action is recommended at these three AREEs based on the results that show target compounds were not present at concentrations greater than the protection standards and background concentrations. Any additional actions that may be required for the Electrical Equipment Facility Pretreatment Tank (AREE 7) will be addressed under the ongoing Resource Conservation and Recovery Act (RCRA) closure.

Based on the results of the streamlined risk assessment, no further action also is recommended at the following AREEs:

- Sewage Treatment Plant (AREE 2)
- EPIC Building (AREE 5)
- Soils at the Former Photographic Wastewater Lagoon (AREE 10)
- Dump #2 (AREE 12)
- Sludge Disposal Area (AREE 13)
- Soils at the Sand Filter Beds (AREE 21)
- Soils at the Possible Sewage Disposal Area (AREE 29-2).

However, EPA believes that additional sampling is necessary to further characterize these AREEs.

One localized area of diesel fuel contamination was detected in the soil at Sugar Tree (AREE 25). No further action is recommended for this AREE because the potential for migration is minimal given the low permeability of the soils, the biodegradability of the

compounds detected, and the limited extent of hydrocarbons detected. However, EPA has requested additional soil samples and a groundwater sample to further characterize this AREE.

No further action is recommended at the Salvage Yard (AREE 29-1) because results from the excavated test pits revealed only inert debris that would not impact the soils at this AREE. However, EPA has requested a soil sample be collected and analyzed to confirm that contamination is not present in the location of the inert debris.

Further investigation activities are recommended for the following nine AREEs where the analytical results exceed the protection standards and background concentrations (where available) for the VHFS project:

- Dump #1 (AREE 1)
- Warehouse (AREE 3)
- Auto Craft Shop (AREE 4)
- Vehicle Maintenance Area (AREE 9)
- Former Sewage Treatment Plant (AREE 11)
- Skeet Range (AREE 14)
- Dump #3 (AREE 17)
- Pistol Range (AREE 19)
- Army, Air Force Exchange Service Station (AREE 27).

Additional investigation of the soil and/or groundwater is recommended at these AREEs to determine the full extent of contamination. Further investigation activities also are recommended for the Possible Disposal Area (AREE 29-3) based on anomalies detected as a result of the geophysical survey conducted in this area.

Further investigations are recommended for the soils at the Firefighter Training Pit (AREE 16) and the Grease Pit (AREE 18) due to uncertainties regarding their locations. Additional soil investigations are recommended at the Former Service Station Abandoned Underground Storage Tanks (USTs) (AREE 28-5) to determine if areas of contamination exist



in the soils above the USTs near the distribution lines and former pump island. A groundwater investigation also is recommended at this AREE because the potential impact to groundwater is unknown.

An additional round of groundwater sampling is recommended at four AREEs to confirm the presence of contamination:

- Former Photographic Wastewater Lagoon (AREE 10)
- Sand Filter Beds (AREE 21)
- Possible Sludge Disposal Area (AREE 29-2)
- Disposal Area (AREE 29-4).

If contamination is confirmed, further investigation activities will be necessary to determine the source of contamination. Additional soil sampling will be conducted at the Disposal Area (AREE 29-4) during the RI in two areas not previously sampled.

No further soil or groundwater investigation activities are recommended at the Outdoor Wash Racks (AREE 26). However, it is recommended that more stringent pollution abatement measures be implemented at the current Outdoor Wash Racks.

Polychlorinated biphenyl (PCB) screening conducted at seven formerly leaking transformer locations showed no evidence of PCBs. Therefore, no further actions are recommended for these sites.

Results from wipe samples collected from the interior walls of two buildings (Buildings 253 and 320) indicate that previous storage of herbicides in the buildings has left residual contamination on the walls. Based on the reuse decision for these buildings, decontamination may be necessary.

The groundwater sample collected from GW01W contained metals, total petroleum hydrocarbons (TPH), phenols, and pesticides above protection standards. Due to this

contamination, the well could not be used to determine background groundwater concentrations. Further investigation is recommended to determine the source of the contamination.

A facility-wide stream assessment also is recommended to determine the condition of South Run and its three tributaries. Surface water and sediment samples should be collected upstream and downstream, from potential source areas identified in this report. The environmental health of South Run is important because this stream discharges into Lake Manassas, a public water supply source.

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## **1. INTRODUCTION**

### **1.1 PURPOSE AND SCOPE**

Science Applications International Corporation (SAIC) conducted a Site Inspection (SI) at Vint Hill Farms Station (VHFS), located near Warrenton, Virginia. The purpose of the SI was to identify the presence and nature of potential environmental contamination. The 27 areas requiring environmental evaluation (AREEs) were identified in the Enhanced Preliminary Assessment (ENPA) conducted by SAIC and are listed in Table 1-1. The work at VHFS was conducted at the direction of the U.S. Army Environmental Center (USAEC) under contract DAAA15-91-D-0017, Delivery Order 0006.

### **1.2 SITE INSPECTION OVERVIEW**

SI activities conducted at VHFS followed the Sampling and Analysis Plan (SAP), Quality Assurance Project Plan (QAPP), and Health and Safety Plan (HASP) that were prepared by SAIC for this effort. These plans were approved for use by USAEC, the Virginia Department of Environmental Quality (VDEQ), and the U.S. Environmental Protection Agency (EPA), Region III. Specific objectives of the SI included:

- Conducting sampling at the AREEs identified in the ENPA as requiring further investigation in order to determine the presence or absence of contamination and the chemical nature of any detected contamination.
- Preparing recommendations for further investigation activities to determine the full extent of contamination, if necessary.
- Evaluating the necessity for immediate response actions, if required.

The SI did not include delineation of the areal extent of detected contamination or detailed geologic/hydrogeologic site characterization.

### **1.3 REPORT ORGANIZATION**

Section 1 of this report provides background information for VHFS and describes the AREEs at which SI activities were performed. Section 2 describes the inspection activities

**Table 1-1. AREEs Investigated During Site Inspection  
Vint Hill Farms Station, Warrenton, Virginia**

AREE 1	Dump #1
AREE 2	Sewage Treatment Plant (STP)
AREE 3	Warehouse
AREE 4	Auto Craft Shop
AREE 5	Environmental Photographic Interpretation Center (EPIC) Building
AREE 7	Electrical Equipment Facility Pretreatment Tank
AREE 9	Vehicle Maintenance Area
AREE 10	Former Photographic Wastewater Lagoon
AREE 11	Former Sewage Treatment Plant (STP)
AREE 12	Dump #2
AREE 13	Sludge Disposal Area
AREE 14	Skeet Range
AREE 16	Firefighter Training Pit
AREE 17	Dump #3
AREE 18	Grease Pit
AREE 19	Pistol Range
AREE 20	Incinerator
AREE 21	Sand Filter Beds
AREE 24	Transformer Storage Area
AREE 25	Sugar Tree
AREE 26	Outdoor Wash Racks
AREE 27	Army, Air Force Exchange Service (AAFES) Service Station
AREE 28-5	Former Service Station Abandoned Underground Storage Tanks (USTs)
AREE 29-1	Salvage Yard
AREE 29-2	Possible Sludge Disposal Area
AREE 29-3	Possible Disposal Area
AREE 29-4	Disposal Area

conducted at VHFS, including geophysical surveys, field screening, soil organic vapor (SOV) surveys, surface and subsurface soil sampling, groundwater monitoring well installation, water sampling, hydraulic push sampling, wipe samples, test pits, a sewerline video, and topographic surveying. In addition, field protocols, including decontamination, waste handling, field equipment operation, health and safety, and quality assurance/quality control (QA/QC), are discussed in Section 2. Section 3 provides the results of the field investigation, including a discussion of the site geology as observed from geotechnical and hydrogeological data. A data quality assessment of the laboratory analytical results and a discussion of these results on an AREE-specific basis also are provided. Section 4 presents SAIC's conclusions and recommendations for the AREEs based on the results of the inspection. Section 5 lists the references used in preparing this SI report. Appendices A through M contain field program reports, data tabulations, data quality assessment details, and information on applicable protection standards for soil, sediment, surface water, and groundwater.

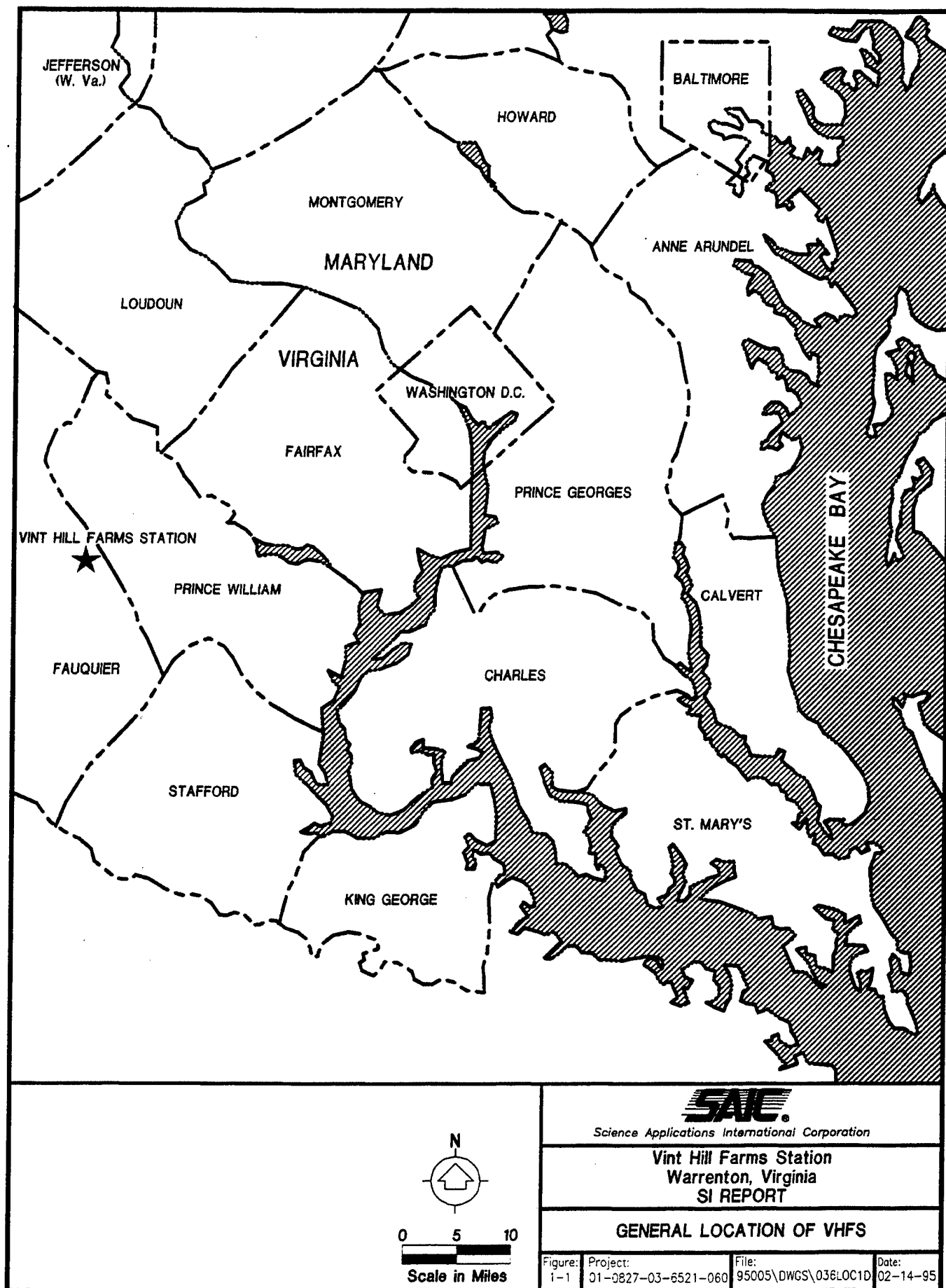
## **1.4 INSTALLATION BACKGROUND**

The following sections provide an installation description, an overview of industrial operations and hazardous material handling, and the property history for VHFS.

### ***1.4.1 Installation Description***

VHFS covers 701 acres and is located in rural Fauquier County in northern Virginia, as shown in Figure 1-1. The southern portion of the property consists of approximately 150 acres of improved grounds used for industrial operations, administration buildings, and residential housing. East of this area are 94 acres of mature hardwood forest. The majority of the remaining 116 unimproved and 341 semi-improved acres in the northern portion of the property are used as stationary and mobile antenna operation sites.

VHFS is part of the Communications-Electronics Command (CECOM), a major subordinate command of the U.S. Army Materiel Command (AMC). The installation is host to a variety of activities and tenants with varying missions. The two main activities involve the Intelligence Materiel Management Center (IMMC) and the Intelligence Electronic Warfare Directorate (IEWD). IMMC provides integrated wholesale and specialized logistics support to



the U.S. Army, U.S. Department of Defense (DOD) customers, and foreign allies for assigned Signals Intelligence/Electronics Warfare weapons systems and equipment. IEWD provides effective signals intelligence, communications jamming, and intelligence fusion material capability to the U.S. Army.

#### ***1.4.2 Description of Facilities***

Specific AREE descriptions are contained in Section 1.5. An overview of three major industrial operations and hazardous material handling operations is presented below.

##### **1.4.2.1 Industrial Operations**

Three major industrial operations have existed at VHFS; two have been operated by the U.S. Army and one by a Government tenant agency (i.e., EPA). The first industrial operation was within the electrical equipment facility (Building 2400). The facility was used for metal etching, photographic development, sandblasting, and painting. The liquid waste products of these processes were filtered, neutralized, and then discharged to the sanitary sewer.

The second industrial operation is within the Vehicle Maintenance Area (AREE 9). Minor vehicle repairs are performed in this area. The wash racks in the maintenance shops drained to the storm sewer system after passing through sediment traps. The floor drains, sinks, and other drains in the service bays discharged either into neutralization pits, which lead to the sanitary sewer, or directly to the sanitary sewer.

The third industrial operation was performed by EPA within the Environmental Photographic Interpretation Center (EPIC) Building (AREE 5). This facility developed film and interpreted photographs of environmental interest. Both color and black and white film were processed. An ion-exchange system was used to recover silver and regenerate ferric cyanide bleach before discharge to the sanitary sewer.



#### **1.4.2.2 Hazardous Wastes Storage and Disposal**

Various satellite storage areas and central storage areas are used to store hazardous wastes before disposal. Satellite accumulation points for hazardous wastes are located in the electrical equipment facility (Building 2400), Auto Craft Shop (AREE 4), and Vehicle Maintenance Area (AREE 9). Automotive and painting wastes from these buildings were stored in these areas. Previously, these wastes were transferred to the hazardous waste storage building, a 90-day central storage area, prior to disposal. However, the storage building has been closed and the wastes are currently collected directly from the satellite storage areas by the hazardous waste transporter. The EPIC Building (AREE 5) had used a hazardous waste/materials storage building to store photographic chemicals and wastes. These chemicals included starter (acetic acid), developer (sulfuric acid), fixer (sodium bisulfite), replenisher (hydroquinone), and bleach (potassium ferricyanide).

Dump #1 (AREE 1), the Former Photographic Wastewater Lagoon (AREE 10), and the Sludge Disposal Area (AREE 13) previously were used for surface and subsurface hazardous waste disposal. These materials included sandblasting wastes, photographic wastewaters, and sewage sludge.

#### **1.4.3 Property History**

VHFS was purchased by the War Department from Margaret and John Harrison in July 1942. Construction of temporary buildings began, and troops were transferred to VHFS from Fort Monmouth and Hancock, New Jersey. Lt. Robert Pope was assigned as the first Post Commander.

During World War II, VHFS served as a training center for signal corps personnel, and as a refitting station for signal units returning from combat before future overseas deployment. These training activities were transferred from VHFS to Carlisle Barracks, Pennsylvania, in March 1949.

Permanent housing for troops and dependents was built and improved upon during the late 1940s. During and after the Korean Conflict, VHFS expanded its facilities in support of

military intelligence and communication activities. In addition, significant improvements were made in the areas of living and recreational buildings. The gymnasium, theater, service club, post exchange, and bowling alley were built during the early 1950s.

Since the Korean Conflict, various activities and tenants have been present at VHFS. In 1961, the U.S. Army Electronic Material Readiness Activity was moved to VHFS. In 1973, EPA took over operation of the photographic interpretation center from the Defense Intelligence Agency (DIA). In 1974, the mission of VHFS refocused to a research and development role, with production of new signals warfare technology for military intelligence. AMC became the major command for VHFS in 1987. VHFS is currently under the Major Subordinate Command of CECOM.

In 1976, approximately 14 acres along the northwest boundary of VHFS were exsessed. Part of this area, which is at the corner of State Routes 215 and 652, serves as a county park. In 1979, approximately 5 acres of VHFS land were sold to the Commonwealth of Virginia, Department of Highways for a right-of-way at the northern boundary. These property transactions reduced the size of the facility to the current 701 acres.

In 1990, the Defense Base Realignment and Closure (BRAC) Act established the formal process to identify those DOD facilities that are suitable candidates for closure. The 1990 BRAC Act serves to accommodate the reduction in DOD forces by identifying which activities may be relocated and which DOD installations may be permanently closed, eventually allowing real property transfer at the closed installation as per the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). In March 1993, the Base Realignment and Closure Commission submitted its recommendation that VHFS be selected for closure under Public Laws 100-526 and 101-510.

## **1.5 AREE DESCRIPTIONS**

The SAIC ENPA team identified 42 AREEs at VHFS. These AREEs include the sites identified in the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) Waste Site Report and any other potential areas of concern identified during the ENPA, file search, or

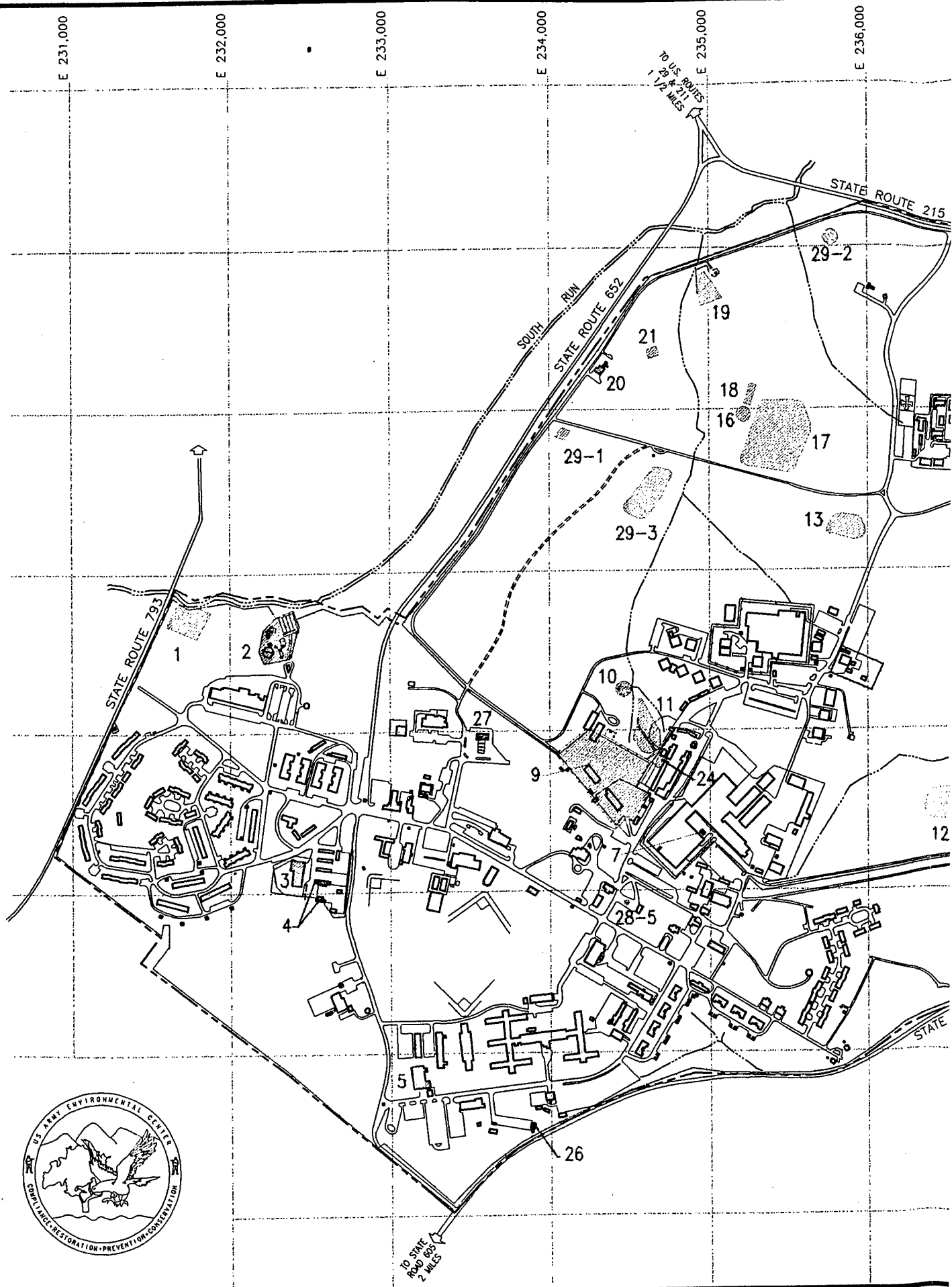
interviews. Three of the 42 AREEs had known contamination and investigations were conducted under separate contract. Twelve of the 42 AREEs had no evidence of releases of hazardous materials or wastes to the environment, and thus were not recommended for further action. SI activities were conducted at the remaining 27 areas. Each AREE inspected is shown in Figure 1-2 and described below. In addition to the 27 AREEs, SI activities also were conducted at two former pesticide storage areas and seven formerly leaking transformer sites. Each facility description includes the types and quantities of associated hazardous wastes and materials, dates of operation, and significant historical events or changes.

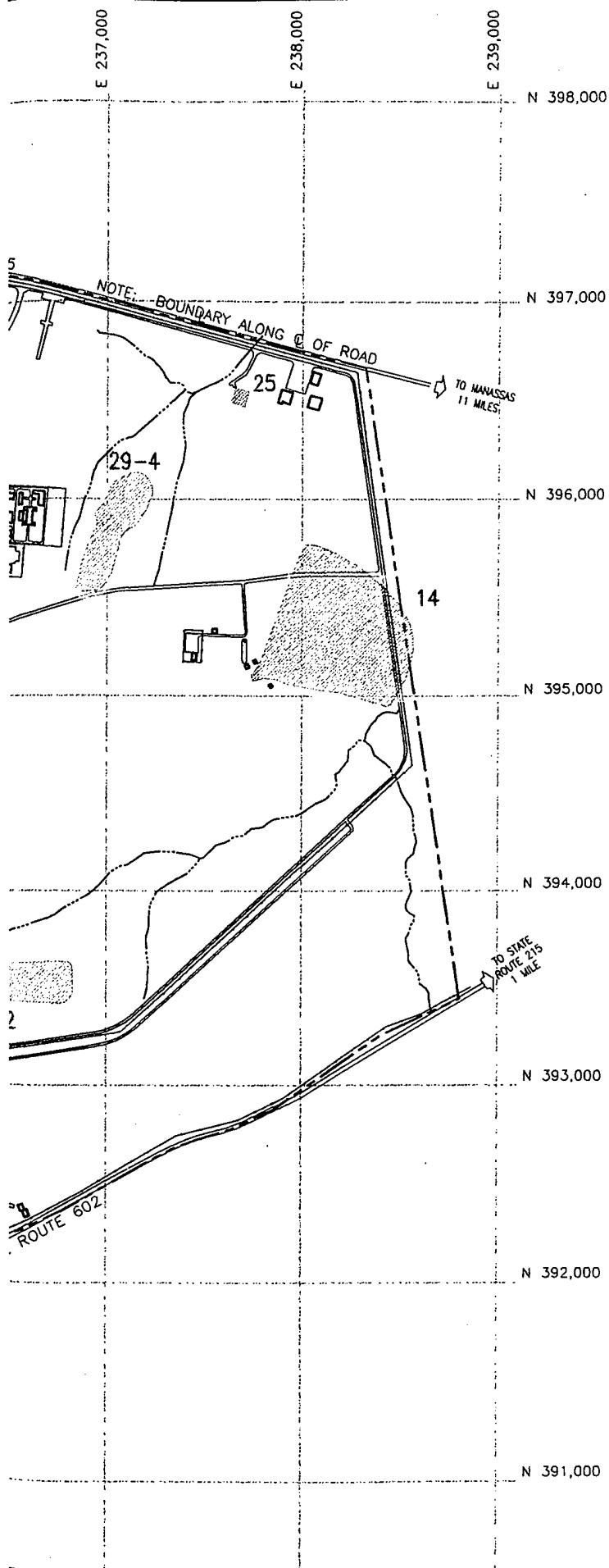
#### *1.5.1 AREE 1 - Dump #1*

This landfill was used for general refuse and installation waste disposal from 1942 to 1973. During this period, approximately 9,000 gallons of paint, 1,800 gallons of solvents, 15,000 pounds of sandblasting waste containing lead paint, and 90,000 tons of household garbage were burned and buried in trenches (ESE 1981). Kitchen grease, waste oil, pesticides, and herbicides also were disposed of in trenches within the 5-acre dump. In addition, sludge from the sewage treatment plants may have been disposed of within the dump. Open burning of asbestos sheeting on the landfill occurred in 1973.

Operations consisted of trench and fill with trenches 6 to 10 feet deep being excavated and used for burning garbage and other wastes. When a trench was filled with ash and unburned residue, it was covered and another trench was excavated. When no more trenches could be excavated, trash was burned on the surface of the dump and ash and unburned residue were spread toward South Run. When the Incinerator (AREE 20) was completed in 1973, disposal of burnable wastes was stopped and the site was used only for disposal of construction debris and other hard fill material. Dump #1 has been covered with grass since disposal activities were stopped in 1973.

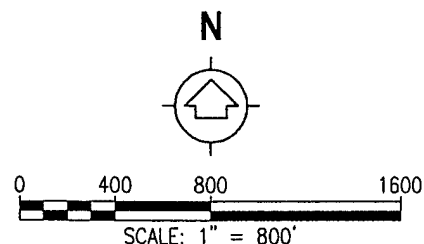
The areas surrounding Dump #1 consist of a former salvage yard to the south, a construction material borrow pit to the west, South Run to the north, and a wooded area to the east. Solid wastes were separated in the former salvage yard to remove reusable and marketable materials (e.g., pipes, iron sheeting, copper wire). Numerous buried metallic features and an





## AREEs LOCATIONS:

- 1 ..... DUMP #1
- 2 ..... SEWAGE TREATMENT PLANT
- 3 ..... WAREHOUSE
- 4 ..... AUTO CRAFT SHOP
- 5 ..... EPIC BUILDING
- 7 ..... ELECTRICAL EQUIPMENT FACILITY PRETREATMENT TANK
- 9 ..... VEHICLE MAINTENANCE AREA
- 10 ..... FORMER PHOTOGRAPHIC WASTEWATER LAGOON
- 11 ..... FORMER SEWAGE TREATMENT PLANT
- 12 ..... DUMP #2
- 13 ..... SLUDGE DISPOSAL AREA
- 14 ..... SKEET RANGE
- 16 ..... FIREFIGHTER TRAINING PIT
- 17 ..... DUMP #3
- 18 ..... GREASE PIT
- 19 ..... PISTOL RANGE
- 20 ..... INCINERATOR
- 21 ..... SAND FILTER BEDS
- 24 ..... TRANSFORMER STORAGE AREA
- 25 ..... SUGAR TREE
- 26 ..... OUTDOOR WASH RACKS
- 27 ..... AAFES SERVICE STATION
- 28-5 ..... FORMER SERVICE STATION ABANDONED USTs
- 29-1 ..... SALVAGE YARD
- 29-2 ..... POSSIBLE SLUDGE DISPOSAL AREA
- 29-3 ..... POSSIBLE DISPOSAL AREA
- 29-4 ..... DISPOSAL AREA



**SAIC**

Science Applications International Corporation

Vint Hill Farms Station  
Warrenton, Virginia  
SI REPORT

### GENERAL LOCATION OF AREEs

Figure: 1-2	Project: 01-0827-03-6521-065	File Name: /95005/DWGS/413S-A1	Date: 05-31-96
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abandoned gas line were detected by electromagnetic (EM) surveys conducted in this area by Environmental Science and Engineering, Inc. (ESE) in 1984.

A monitoring program was initiated in 1984 to investigate the groundwater quality near the site. The site is monitored by four groundwater monitoring wells, including two wells that monitor the fractured bedrock beneath the landfill, one that is located east of the landfill, and one well located upgradient (south) of the landfill. Leachate from the landfill has been observed entering South Run (ESE 1986). Considering the types of materials reported to have been disposed of in the landfill, migration of toxic materials may have occurred. However, cyanide, metals, or volatiles above state criteria were not detected in surface water samples collected by ESE in 1984 from a leachate seep and immediately below the toe of the landfill. Chromium was detected in the landfill surface soils and stream bed sediments at 28 and 33 mg/kg, respectively. These concentrations were above the background chromium concentration of 24 mg/kg.

#### *1.5.2 AREE 2 - Sewage Treatment Plant*

The Sewage Treatment Plant (STP) serves 400 VHFS permanent residents and 2,000 daily employees and has been in service since 1952. The plant treats and discharges industrial and sanitary wastewaters from VHFS operations. The facility has received sanitary wastewater, industrial wastewater (from photographic, painting, laboratory, vehicle washing, and metal etching operations), and surface water runoff.

Before 1973, wastewater was treated by sedimentation and chlorination prior to discharge. Since that time, improvements have been made to the facility to bring the plant into compliance with current requirements. After the capacity of the STP was expanded in 1981, the Former STP (AREE 11) was closed and all sanitary wastewaters were piped to the STP. In 1990, bar screen/grit chamber equipment was installed to remove large solids and grit at the headworks of the plant. An ultraviolet (UV) disinfection system was added in 1992 to replace the chlorine disinfection system. The new system eliminated the residual chlorine formerly discharged as a result of the chlorine contact tank disinfection. Current treatment includes bar screening, grit chamber settling, coagulation with aluminum sulfate (alum), flocculation and

sedimentation, biological treatment with a trickling filter, secondary clarification, and UV disinfection of the effluent.

The sludges from the settling tank and secondary clarifier are aerobically digested and then discharged to one of four sand drying beds. The drying beds were renovated in 1991 to replace the underdrainage system and install a roof. Before 1980, sludge was stored in piles onsite near South Run. Based on aerial photographs and historical practices, the sludge may have been disposed of in Dump #1 (AREE 1), Dump #3 (AREE 17), or the Possible Sludge Disposal Area (AREE 29-2). Currently, the dried sludges are removed every 3 weeks and disposed of in the Fauquier County Landfill. Approximately 10 cubic yards per month of dried and digested sludges are generated and disposed of in the county landfill.

The facility discharges an average of 220,000 gallons/day of treated effluent to South Run. The discharge is regulated by the Virginia State Water Control Board (SWCB) through Virginia Pollutant Discharge Elimination System (VPDES) permit number VA0020460.

Chlorination is no longer used to disinfect the wastewater and all chlorine has been removed from the STP. Some chlorine is still stored in a storage building near the commissary (Building 397) in case the UV disinfection system malfunctions. Currently, the liquid chlorine is only used for the water supply pumphouses and the two swimming pools located on the installation. Canisters of chlorine gas and bags of sodium hexametaphosphate and sodium fluoride for water treatment also are stored in this building. Alum used for coagulation is stored in a 6,000-gallon aboveground fiberglass tank. The tank is housed in a cinder block building that is designed to contain the entire contents of the tank in the event of a rupture.

The STP chemical laboratory (Building 398) routinely performs analyses for compliance with permit and operations parameters of the STP. Small amounts of hazardous materials are stored in the STP chemical laboratory for analytical purposes. These industrial chemicals and small amounts of toxic wastes (e.g., mercuric sulfate from the chemical oxygen demand [COD] analysis) are disposed of in the sink, which leads to the head of the plant.

Effluent discharge to South Run has been monitored extensively by installation personnel and the SWCB under the VPDES permit. The discharge will be sampled monthly for all priority pollutants beginning in September 1995, according to the VPDES permit. Levels of total suspended solids (TSS), biochemical oxygen demand (BOD), phosphate, and total flow that exceed permit limits have been recorded. Concentrations of heavy metals (including silver, chromium, and cyanide) have not exceeded permit levels since EPIC installed a pretreatment system in 1980.

In July 1984, the pretreatment system at the EPIC Building (AREE 5) failed and cyanide-containing wastewaters were discharged to South Run through the STP. In August 1984, 34.0  $\mu\text{g/L}$  of total cyanide and 20.5  $\mu\text{g/L}$  of free cyanide were detected in surface water sampled downstream from the STP discharge (ESE 1986). These levels exceeded Federal and state criteria for protection of aquatic life, but were below criteria for protection of human health. During subsequent sampling in May 1985, 19.1  $\mu\text{g/L}$  of total cyanide were detected and concentrations of free cyanide were nondetectable. Later sampling of the surface water showed further decreases in cyanide concentrations (Chesapeake 1991).

### ***1.5.3 AREE 3 - Warehouse***

The Warehouse (Building 309) reportedly was used to store drums of oil, grease, solvent, paint, acid, and industrial organic chemicals (Weston 1990). However, at the time of the ENPA site visit, the only hazardous substances in storage were industrial cleaners and soaps, spray paint cans, and copier supplies (i.e., toner). Interviews with the manager of the Warehouse indicated that other hazardous substances may have been temporarily offloaded in the Warehouse area, but none was stored in the Warehouse building and no spills had occurred (Rylander 1993). In addition, most shipments of hazardous substances are delivered directly to the user (e.g., IEWD, IMMC, EPIC) or are brought in and out by a subcontractor (e.g., painters, lawn care personnel, insect/rodent control personnel). The Warehouse was built in 1943 and has a concrete floor. At one time, the Warehouse was used as a vehicle maintenance area. The probable dates for such usage would coincide with the timeframe during which the Auto Craft Shop (AREE 4) was used as the VHFS motor pool (1943-1967). Two sets of concrete filled pits



exist in the Warehouse floor. These pits may have been used as hydraulic lifts and fluid-changing pits. A date etched in the concrete indicates 1967 as the year in which the pits were filled. No records exist to indicate whether the pits were cleaned out prior to being filled. One floor drain, approximately 2 by 3 feet, is located at the south end of the building, in a former lavatory area. The top of the drain currently is sealed off with a wooden board. No records exist to indicate when the drain was sealed at the floor level. Currently, the Warehouse sink and water fountain drain pipes run underneath the floor into the floor drain. An outflow pipe runs south from the drain basin. According to the VHFS sewer map, the outflow discharges to the field south of the Auto Craft Shop and Warehouse.

#### *1.5.4 AREE 4 - Auto Craft Shop*

The Auto Craft Shop (Buildings 306 and 308) is where military personnel performed maintenance on their private vehicles until the shop moved to an area west of the Vehicle Maintenance Area (AREE 9) in the fall of 1994. The buildings were used to store oil, solvents, and lubricants for these activities. The buildings have concrete floors with no curbs or floor drains. Gasoline and oil spills have been recorded in this area and were cleaned up using absorbents. The Auto Craft Shop was used from 1943 to 1967 as the motor pool for VHFS.

Waste oil, previously stored in an underground storage tank (UST) prior to its removal in July 1990, is stored in a 500-gallon aboveground storage tank (AST). The 500-gallon steel AST is double-walled and is located under a roof and within a steel containment dike. The dike can contain 110 percent of the contents of the tank in the event of a spill. The tank has two compartments, each clearly labeled, for used antifreeze and waste oil. The used antifreeze and waste oil are removed by private contractors.

An outdoor vehicle wash rack is located adjacent to Building 308. Drain lines for the vehicle wash rack are connected to the storm sewer, which discharges to the field south of the Auto Craft Shop. A grit chamber settles the solids prior to discharge.

Surface water runoff is diverted into a storm sewer drain, which discharges to the field south of the Auto Craft Shop. No previous sampling activities have been conducted in this area

to determine if spills from the Auto Craft Shop have impacted the surrounding soils. However, it has been reported that the grass in this area has an oily sheen after a storm event (Hitt 1993).

A plume of petroleum contamination currently lies under the shop as a result of leaks from the Auto Craft Shop UST that was removed in 1990 (Versar 1990). It is unknown whether releases from the Auto Craft Shop have contributed to this contamination through runoff of solvent, oil, and gasoline spills to the surrounding soils or by infiltration through cracks in the pavement.

#### ***1.5.5 AREE 5 - EPIC Building***

The U.S. Air Force (USAF) Aeronautical Chart and Information Center (ACIC) used the EPIC Building (Building 166) from 1958 to 1963 for photographic development. The building was unoccupied for the next 3 years. In 1966, DIA reactivated the laboratory and used it until 1971. The building was then on standby status for 2 years. EPA began photographic operations at the building in July 1973. The facility developed, enlarged, and printed aerial photographs in color and black and white for EPA using the Kodak EA5 and R-3 processes. EPA moved out of the building at the end of 1995.

Photographic wastewaters are acidic and may contain silver, ferric cyanide, chromium, and other photographic chemicals and cleaners. From 1958 to 1968, untreated black and white photographic wastewater containing silver was discharged to the Former Photographic Wastewater Lagoon (AREE 10) through a 6-inch industrial sewerline. In 1966, the first silver recovery units were installed for wastewater pretreatment. The pond was dredged in 1968 to recover silver in the sediments and then filled in. The effluent was then diverted directly into the western tributary of South Run.

An ion-exchange system was installed in 1973 to remove cyanide, ammonia, phenols, and silver from the photographic wastewater before discharge. Color as well as black and white processing occurred during this period. From 1973 to 1983, the pretreated wastewater was discharged through the industrial sewerline into the western tributary of South Run. The ion-exchange system was 80 to 90 percent effective in removing cyanide, ammonia, phenols, and

silver (ESE 1986). Cyanide (177 mg/L), phenols (25 mg/L), silver (1.32 mg/L), and cadmium (0.14 mg/L) were detected during surface water sampling in April 1978 at the outfall of the sewerline to the tributary. State of Virginia criteria for Class III waters at the time of sampling were 0.005 mg/L for cyanide, 0.001 mg/L for phenols, 0 mg/L for silver, and 0.0012 mg/L for cadmium (ESE 1981).

In October 1983, the industrial sewerline was plugged at the EPIC Building and the photographic wastewaters were diverted into the sanitary sewer. Before discharge to the sanitary sewer, the wastewaters were treated in an upgraded ion-exchange unit. Testing indicated that this unit removed 100 percent of the silver and cyanide. Two ion-exchange systems, each having two columns with resin-coated beads, were used to strip silver thiosulfate or ferric cyanide from the wastewater before discharge to the STP (AREE 2). The beads were periodically regenerated to remove the silver and cyanide.

The EPIC operation was a small quantity generator (SQG) of hazardous wastes and had its own Resource Conservation and Recovery Act (RCRA) generator identification number (VA7690590024). The hazardous wastes included fixing solution containing silver and bleach cleaner containing ferric cyanide. The fixer and the bleach cleaner were treated in the resin columns and discharged through the sanitary sewer.

Nonhazardous color developer and hazardous wastes generated during photographic processing were stored in the EPIC hazardous waste storage building on the loading dock before removal by a private contractor. The nonhazardous color developer was prohibited from being discharged to the sanitary sewer because the developer wastewater raised the chlorine requirements at the STP (AREE 2).

The EPIC hazardous waste storage building also was used to store hazardous raw materials for the Kodak EA5 and R-3 processes. The containment building has three compartments with temperature control, spill containment, and ventilation. Drums of hazardous wastes previously had been stored on the loading dock without containment. The EPIC Building also contains a bermed satellite storage area within the chemical storage room.

The EPIC Building released photographic wastewaters containing silver and ferrocyanide to the Former Photographic Wastewater Lagoon (AREE 10) and the western tributary of South Run through the industrial sewerline from 1958 to 1983. Due to the age of the pipeline and the nature of the acidic wastewaters, leakage is suspected. In addition, silver and cyanide sludges may still be in the pipeline. Infiltration of groundwater into the pipeline may carry these sludges to the surrounding soil and groundwater.

A geophysical survey of the vitrified clay pipeline was conducted in 1984 to provide a qualitative estimate of the leakage from the industrial pipeline. The photographic wastewaters contain high amounts of solids and metals which, theoretically, would be detected by an EM survey. Plumes of contaminants emanating from the pipeline were not detected during the EM survey (ESE 1986). However, it would take an extremely large quantity of contamination to be detected using an EM survey. Therefore, the results are considered inconclusive.

One bedrock monitoring well was installed in 1984 adjacent to the sewerline in a location where a ground conductivity anomaly was detected during the EM survey. Contaminants above Federal maximum contaminant levels (MCLs) have not been detected in samples collected from this shallow well and the two nearby drinking water supply wells.

#### ***1.5.6 AREE 7 - Electrical Equipment Facility Pretreatment Tank***

The electrical equipment facility (Building 2400) was used from 1965 to 1995 for various classified military activities within IMMC. The facility used several hazardous paints, photographic chemicals, and metal-cleaning liquids during its operational period. After use, the paints and cleaners were discharged from the appropriate bins into a drainage network that led to one of two concrete-lined impoundments located adjacent to the building. Acidic photographic wastewaters were first neutralized in the western impoundment (neutralization pit) prior to discharge to the eastern impoundment (pretreatment tank). Currently, the painting and photographic operations have been discontinued and the metal etching operations are infrequently used. All activities using hazardous materials were moved to Building 2472 in 1995. The neutralization pit has been closed since May 1990 and is being investigated under a separate contract.

The pretreatment tank was installed in 1978 and was approximately 6 feet long, 4 feet wide, and 5 feet deep, with concrete sides and bottom. The tank contained a layer of rock and a layer of sand to filter the wastewaters before discharge to the sanitary sewer. Overflow from the sand filter entered the sanitary sewer directly. The water discharged to the sanitary sewer in the area of manhole 29-1 and flowed in a northwest direction toward the lift station and ultimately to the STP. From 1978 to 1990, approximately 200 gallons/month of waste chromic acid from the metal etching operations, painting wastewaters, and photographic wastewaters (from the neutralization pit) entered the pretreatment tank. From 1991 to 1995, only 50 gallons/month of chromic acid from the metal etching operations entered the pretreatment tank. The tank was closed by VHFS personnel in 1995 and no cracks in the concrete walls or stained soils were noted.

Between 1978 and 1990, all floor drains discharged spills and floor washwaters to the pretreatment tank. Before 1978, all floor drains discharged directly to the western South Run tributary through outfall 401.

Since 1981, the sand sludge in the pretreatment tank had been removed annually and disposed of as hazardous waste by the Defense Reutilization and Marketing Office (DRMO). This material was classified as hazardous waste because of the chromium, silver, and lead content. Prior to 1981, the sand sludge was disposed of in the Sludge Disposal Area (AREE 13).

Chemicals that were stored in the electrical equipment facility included chemical agent resistant coating (CARC) paint, thinners, iridite (used in acid etching and metal cleaning), deoxidizer, aluminum etch #2, cleaning solvents, waste solvent, and residue from sandblasting. Spills of these chemicals would have entered the pretreatment tank through the floor drains.

Used solvents and other hazardous wastes were stored in 55-gallon drums outside the building in a hazardous materials satellite accumulation area. The holding area is a concrete containment building with berms to prevent spills and leaks from reaching the surrounding soils.

Unused hazardous materials are stored in a fireproof building (Building 292) outside of the electrical equipment facility. The building is used to store assorted paints, thinner, ammonia, ferric chloride, methyl ethyl ketone (MEK), toluene, aluminum etching powder, hydraulic fluid, and cylinders of argon and oxygen.

Surface water and sediment sampling was conducted in April 1978 at the outlet of the floor drains to the western South Run tributary. Cadmium, mercury, and cyanide were detected in the surface water, and chromium, mercury, and silver were detected in the sediments.

The pretreatment tank wastewater was tested in April 1992 using the toxicity characteristics leaching procedure (TCLP). These analyses detected benzene, chloroform, MEK, barium, cadmium, lead, and chromium at leachable concentrations. Although detected above the instrument detection limit, all concentrations were below levels that would classify the wastewater as hazardous.

#### ***1.5.7 AREE 9 - Vehicle Maintenance Area***

The VHFS vehicles are maintained at the civilian motor pool (Building 288), while the vehicles for the 201st Military Intelligence Battalion are maintained in the military motor pool (Building 290). The two maintenance areas have been used since 1967 and are separated by a fence. The buildings both have wash racks and grease racks for vehicle maintenance activities. Drains from the wash racks lead to grit chambers, which discharge to the western South Run tributary, while drains from the grease racks discharge directly to the sanitary sewer. A neutralization pit exists outside each of the motor pools. Battery acid and other chemicals were reported to have been disposed of in the sinks that lead to the neutralization pits. The pit located outside of Building 290 has an earthen bottom, while the pit located outside of Building 288 has a concrete bottom.

The Vehicle Maintenance Area has a designated area for hazardous waste and materials storage. The area is fenced and contains a roofed 10- by 10-foot bermed concrete pad. Four polyethylene ASTs, installed in 1990, are on the pad for waste oil (300-gallon capacity), transmission fluid (200-gallon capacity), dry cleaning solvent (200-gallon capacity), and used

antifreeze (200-gallon capacity). Used oil filters and used batteries also are stored on the pad. In addition, the pad is used to store hazardous raw materials, including oils, solvents, and antifreeze. Five-gallon cans of gasoline and paint were stored off the pad, but within the fenced area. The hazardous wastes are removed periodically by DRMO.

Four gas pumps are in the eastern portion of the Vehicle Maintenance Area for dispensing gasoline and diesel fuel previously stored in two 2,000-gallon diesel tanks and one 10,000-gallon gasoline tank. These USTs were removed and replaced with a single AST. The UST removal was a clean closure with no evidence of a release. The AST contains two chambers of 1,000 gallons each for dispensing either diesel or gasoline. The fuel pump house (Building 287) is used for filling civilian, government, and military vehicles. One 55-gallon drum of motor oil and one 55-gallon drum of antifreeze are stored in this building. A cinder block building (Building 289) outside the civilian motor pool is used for paint storage. Drums of unused antifreeze and oil are stored in the civilian motor pool.

The fire department has reported numerous spill incidents in this area and many stains were observed on the asphalt during the ENPA site visit (SAIC 1994a). However, most spills were reported to be contained before they reached one of the stormwater drains.

#### ***1.5.8 AREE 10 - Former Photographic Wastewater Lagoon***

The Former Photographic Wastewater Lagoon was an earthen holding pond approximately 90 feet in diameter and 4.5 feet deep. From 1958 to 1968, photographic wastewaters from the EPIC Building (AREE 5) were discharged to the lagoon. The black and white photographic wastewater was acidic and contained significant amounts of silver. The overflow from the lagoon discharged to the western South Run tributary. In 1968, flow problems developed and the lagoon was dredged to recover silver from the sediments. The lagoon was then filled in and effluent was diverted directly to the South Run tributary. The lagoon has not been used since this time.

During its operational period from 1958 to 1968, silver entered the lagoon at a rate of 100 kg/year and dissolved silver in the western South Run tributary reached concentrations of

0.213 mg/L (ESE 1981). Silver concentrations in the western South Run tributary in 1978 were 1.32 mg/L in the surface water and 2.0 mg/kg in the sediments.

#### ***1.5.9 AREE 11 - Former Sewage Treatment Plant***

The Former STP was constructed in 1943 and used until 1981 to treat sanitary wastewaters at VHFS. The newer STP (AREE 2) was constructed in 1952 to increase the treatment capacity and allow additional housing on the installation. The Former STP was closed in 1981, and a Dyncorp storage lot for vehicles and construction materials currently covers one-half of the area. The remainder of the area is an open, grass-covered field.

During plant closure, the sludges in the drying beds and sludge piles were disposed of in the Sludge Disposal Area (AREE 13) and the structures were drained and razed. During excavation for the construction of the Dyncorp storage lot, additional structures associated with the Former Sewage Treatment Plant were found.

The plant originally used only sedimentation and chlorination to treat the sanitary wastewaters before discharge to the western South Run tributary. The discharge was monitored by the Virginia SWCB through National Pollutant Discharge Elimination System (NPDES) permit number VA0002569. Approximately 67,000 gallons/day were discharged during its operational period. A trickling filter was added later as biological treatment. The sludges from the sedimentation tank were dried in sludge drying beds and then stored onsite in piles near the western South Run tributary.

During its operational period, the Former STP discharged a minimum of hazardous contaminants. The plant effluent was sampled in April 1978 and the only primary pollutants detected were phenols (0.02 mg/L) and mercury (0.001 mg/L).

The dried sludge stored in piles near the western South Run tributary contained silver (250 mg/kg), mercury (40 mg/kg), and chromium (40 mg/kg). In April 1978, silver (56 mg/kg), mercury (6.2 mg/kg), and chromium (94 mg/kg) were detected above background concentrations in sediments in the South Run tributary. Silver and mercury were not detected



in background sediment samples from South Run collected upstream of VHFS. Chromium was detected in the sediments at 24 mg/kg. Groundwater monitoring was required under the previous VPDES permit for the plant. Silver, mercury, chromium, phenols, and cyanide were not detected in a bedrock monitoring well located downgradient from the treatment plant (ESE 1986).

#### ***1.5.10 AREE 12 - Dump #2***

Aerial photographs indicate that Dump #2 has been used as a construction debris disposal area since 1958. Extensive ground scarring and piles of dark material were observed in the photographs. An active access road led to the site from Patrol Road.

In 1983, VHFS obtained Solid Waste Disposal Facility Permit #423 from the Virginia Department of Waste Management (VDWM) to dispose of inert construction debris in Dump #2. Approximately 3 tons/month of debris waste (e.g., concrete, asphalt, wood, and miscellaneous metals) were disposed of in the 1-acre dump. Asbestos wastes also may have been disposed of in the dump.

VHFS closed Dump #2 in 1985. The compacted fill material was covered with 18 inches of clay and 6 inches of top soil, and was then seeded with grass.

#### ***1.5.11 AREE 13 - Sludge Disposal Area***

The Sludge Disposal Area is located in the antenna fields in the north-central portion of the installation, near the intersection of West and Bicher Roads. The area was used during the 1980s to dispose of sludge from the STP (AREE 2) and Former STP (AREE 11). The sewage sludges were analyzed for total metals in 1982 and were found to be sufficiently low for land spreading (38 mg/kg silver, 5 mg/kg arsenic, 1.6 mg/kg cadmium, 45 mg/kg lead, and 3.4 mg/kg mercury). The 75-foot diameter and 3-foot high sludge pile also received 200 gallons/year of sand filter sludge (containing metal etching wastes) and sandblasting waste (containing lead paint) from the Electrical Equipment Facility (Building 2400). In June 1992, the area was excavated and closed as part of a consent order with Virginia SWCB that included cleaning out the digester. Twenty thousand cubic feet of sludge were excavated, mixed with

pressed sludge cake from the STP (AREE 2) digester, and transported to the Fauquier County Landfill. Currently, the area is level, grassed, and barely distinguishable from the surrounding area. Metals above background concentrations were not detected in surficial soil samples collected in this area after the sludges were removed.

Cyanide, phenols, and ammonia were detected in 1984 in three U.S. Army Environmental Hygiene Agency (USAEHA) monitoring wells downgradient from the area (ESE 1986). Possible sources include the Sludge Disposal Area, Former Photographic Wastewater Lagoon (AREE 10), Dump #3 (AREE 17), or the western South Run tributary. Cyanide and phenols were not detected in the two subsequently collected groundwater samples. These wells have been abandoned.

#### ***1.5.12 AREE 14 - Skeet Range***

The outdoor Skeet Range was used from 1961 to 1995 for shotgun target practice on the weekends. The Skeet Range firing fan is oriented north and eastward in an 800-foot radius. The spent ammunition (i.e., lead and steel shotgun pellets) is spread out over the range and is not recovered. An archery range and a golf driving range are southeast of the Skeet Range.

#### ***1.5.13 AREE 16 - Firefighter Training Pit***

The Firefighter Training Pit was formerly used by the VHFS Fire Department for training once each month during the mid-1970s (Hitt 1993). The unlined pit was approximately 50 feet in diameter and 3 feet deep. During training activities, the pit was partially filled with petroleum and natural gas odorant and then ignited. Solvents and other combustibles also may have been used in the pit.

During its 3- to 4-year operational period, up to fifty 55-gallon drums of waste oil and two 1,500-gallon tanks of JP-4 were stored on an unbermed area south of the pit. These materials were removed in 1981 and donated to the Catlett County Fire Department (ESE 1981).

Fire-fighting activities ended in the late 1970s and the pit has not been used since this time. In the mid-1980s, the pit was filled with ½-inch gravel, reportedly from the trickling filter (Hitt 1993), although only sparse amounts of gravel are noticeable at the site.

Two empty USTs, previously used to store diesel oil for the Manassas Family Housing Site, were placed on the covered pit in 1988 (Reisch 1993). The tanks were removed from the area in 1993 and ground scarring indicates where the tanks had been placed. In addition, some debris from a trickling filter, fiberglass insulation, 10-foot lengths of rusted ductile iron pipe, and a tank fill pipe with attached concrete were found near the pit during the ENPA site visit.

#### *1.5.14 AREE 17 - Dump #3*

Dump #3 has been used to dispose of compost materials (i.e., leaves, branches, grass, and tree stumps) and construction debris (i.e., "clean fill" such as soil, asphalt, and concrete). Sludge from the STP (AREE 2) and the Former STP (AREE 11) also may have been disposed of in Dump #3. According to aerial photographs, the area has been used since 1958 as a disposal area (EPIC 1983). The dump is approximately 390 by 318 feet and a 300- by 318-foot section is currently surrounded by a low wire fence.

The area was freshly plowed and leveled during the second ENPA site visit in October 1993. All construction debris and nondegradable materials were sent to the Fauquier County Landfill. The dump has been used since that time only for composting.

Small amounts of sandblasting waste containing lead paint from the Electrical Equipment Facility (Building 2400) may have been disposed of in this area (O'Neill 1993). In addition, some household waste and empty insecticide bottles were observed in the dump during the first ENPA site visit in September 1993. Material was deposited over the fence at various points around the dump. One bedrock monitoring well was installed downgradient from the area in 1984.

#### ***1.5.15 AREE 18 - Grease Pit***

The Grease Pit was reportedly 50 feet long, 2 feet wide, and 4 feet deep (Weston 1990). The trench was used to dispose of kitchen grease and oily rags. Motor oils also may have been disposed of in the trench. The pit was covered in 1981 and has not been used for oil or grease disposal since this time. Currently, ground scars cover a 25- by 70-foot area within which the 2- by 50-foot grease pit is thought to have been contained. The oils may have been remediated through natural biodegradation; however, used motor oils contain metals, which would persist in the subsurface environment.

#### ***1.5.16 AREE 19 - Pistol Range***

The Pistol Range has been used since 1961 for limited target practices. The 100- by 200-foot area is partially surrounded by a fence. The firing fan is directed southward toward a horseshoe-shaped dirt bank, which captures the bullets. Weapons used at the pistol range include .22, .32, .38, and .45 caliber handguns. Spent ammunition is not recovered, but shell casings are collected and returned to the fixed ammunition magazine. The facility was used once in 1992 for detonation of an inert bazooka round that was unearthed during gas line digging activities. The bazooka round was determined to have been a training round because no testing, placing, or firing of live ordnance has occurred at VHFS.

#### ***1.5.17 AREE 20 - Incinerator***

The Incinerator (Building 282) was used from 1973 to 1985 to burn household and office garbage. Medical wastes from the medical clinic also were accepted at the facility until April 1983. The two-chambered incinerator (Scientific Ecology Model DACA 31-72) has a design capacity of 2 tons/hr for type 1 wastes (i.e., household garbage) and has produced an 89 percent weight reduction from garbage to ash. During its period of operation, the facility received approximately 12 tons of solid waste each day. The ash and nonburnables were then sent to the Fauquier County Landfill.

The Incinerator was closed from 1985 to 1987 for renovations. After restarting in April 1987, the Incinerator shut down in July 1987 when a series of explosions in the furnace damaged

the structure. The Incinerator was rarely operated properly, primarily due to inexperienced operators and a lack of preventative maintenance (USAEHA 1983). The Incinerator has not been used since this time and all VHFS solid waste is taken to the Fauquier County Landfill. The Incinerator building currently is used for overflow storage (i.e., boxes, pallets, and miscellaneous machinery parts). The Virginia Air Pollution Control Board (APCB) considers the facility permanently closed (Clayton 1993). Although most of the ash has been removed from the structure, some residual ash still remains in the ducts and furnace.

The facility also received many nonburnable materials, including auto parts, hazardous household refuse (e.g., car batteries, solvents, pesticides, etc.), and all types of metal. Most of these materials were removed before incineration, but some of the materials may have inadvertently entered the furnace.

Air pollution controls included a stack gas scrubber and a baffle system. The scrubber used water sprays for particulate control in the smokestack (i.e., a wet scrubber). The wastewater from the scrubber was discharged through a 6-inch pipe to the Sand Filter Beds (AREE 21), which lie 300 feet northeast of the Incinerator.

A 500-gallon septic tank and a 135-foot leach field lie north of the facility. The septic system is connected to the sinks, toilets, and floor drains in the Incinerator building. There is no record of hazardous wastes having been disposed of in the septic system.

Hazardous materials (e.g., solvents, pesticides, and waste oil) have been disposed of in the Incinerator. The high temperatures would have destroyed most of the contaminants, but the residual ash would contain high levels of soluble metals. Currently, some residual ash remains within the building. Spills of liquid hazardous wastes (e.g., solvents, pesticides and waste oils) would have been captured by the floor drains and discharged to the septic system. All floor washings also were discharged to the septic system.

#### ***1.5.18 AREE 21 - Sand Filter Beds***

The Sand Filter Beds received the ash wastewaters from the wet scrubber, which was used for particulate control in the Incinerator (AREE 20) smokestack. The two beds are each 10 by 25 feet and have 12-inch thick concrete walls (USACE 1973). However, the bottoms of the beds are unlined. The 3.5-foot deep beds contain a 2.5-foot layer of coarse sand (0.5 mm diameter) and 1 foot of filter gravel (½- to 1-inch diameter) to filter particulates from the wastewater. An underdrain system in the gravel filtered the solids from the ash wastewater and drained the effluent to a distribution box. The wastewater then discharged through perforated pipe to a leach field north of the Sand Filter Beds. The beds are currently uncovered and filled with weeds. According to facility personnel, the beds have never been cleaned out to remove the ash particulate (Reisch 1993).

Because hazardous materials have been disposed of in the Incinerator (AREE 20), contaminants could be present in the sand beds, distribution box, piping, and leach field. The leach field drains into the western South Run tributary, which has exhibited elevated concentrations of cyanide, phenols, and mercury in the surface water (ESE 1986).

#### ***1.5.19 AREE 24 - Transformer Storage Area***

The Transformer Storage Area is located west of Building 272 in the engineering compound. This formerly unbermed asphalt area was used to store polychlorinated biphenyl (PCB) transformers (i.e., PCBs in oil greater than 500 parts per million [ppm]) and PCB-contaminated transformers (i.e., PCBs in oil between 50 and 500 ppm) before removal by Aptus Environmental Services in 1990. In addition, non-PCB transformers may have been stored in the area. The area currently is bermed and covered and is used for general storage of materials on pallets, including new non-PCB transformers. The area also has been used to store drums containing oil and fuel filters (Reisch 1993). Any spills of transformer cooling oil could migrate toward the western South Run tributary. However, no spills were observed or recorded in this area.

An environmental survey of 30 VHFS buildings was conducted in 1989. During the survey, it was noted that six 55-gallon waste motor oil drums in the Engineering Complex (near the Transformer Storage Area) were leaking and had saturated the surrounding soil.

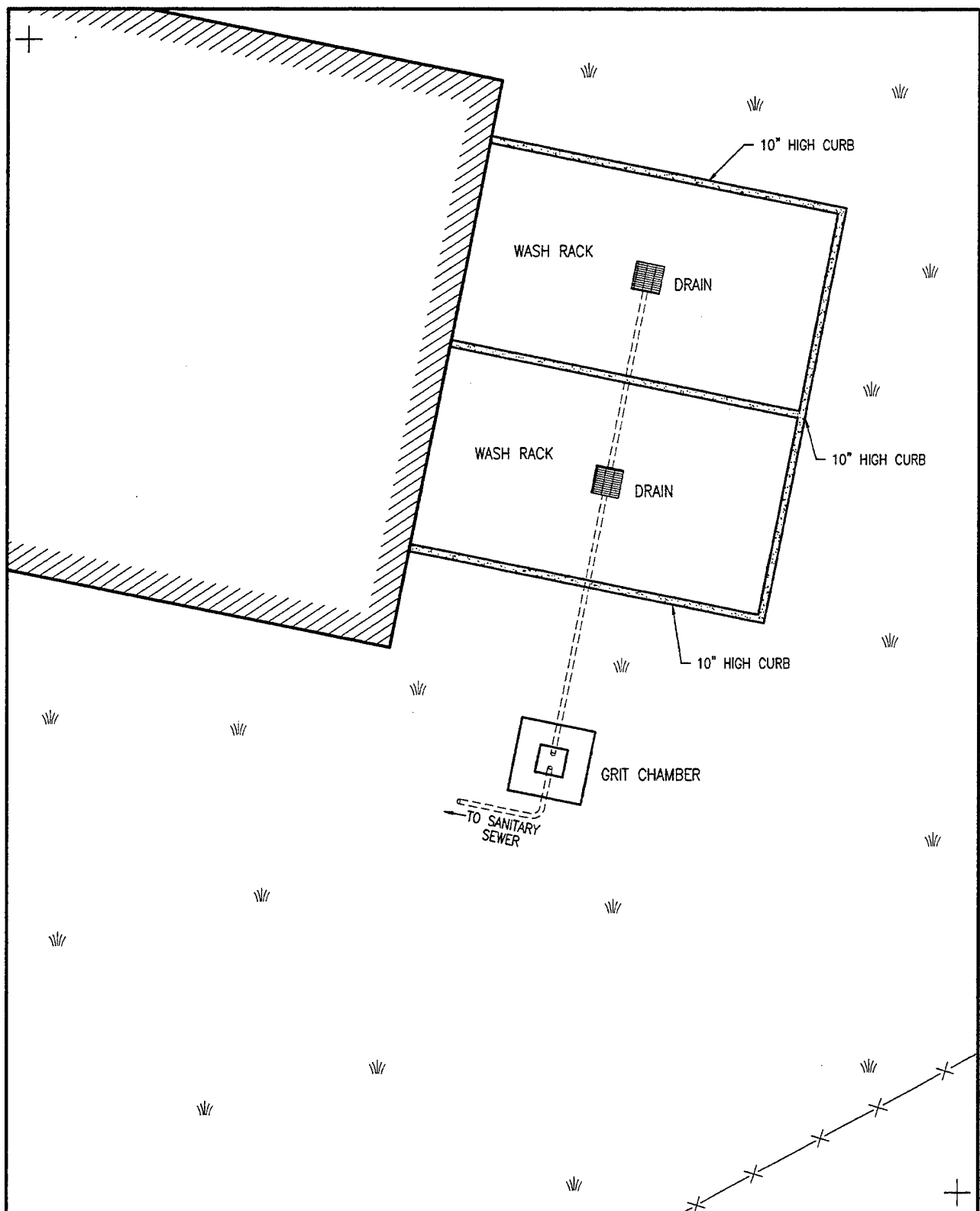
#### ***1.5.20 AREE 25 - Sugar Tree***

Small amounts of paints and solvents may have been disposed of in the Sugar Tree. However, no stressed vegetation or other evidence of contamination was observed in the area. During the ENPA site visit, nine 5-gallon gas tanks and a 200-gallon diesel AST with plastic sheeting for secondary containment were observed in the area. The AST was being used temporarily to store diesel fuel for vehicles involved in the construction of a sewage lift station. According to VHFS personnel (Reisch 1995), the AST was located in this area for approximately 6 months.

#### ***1.5.21 AREE 26 - Outdoor Wash Racks***

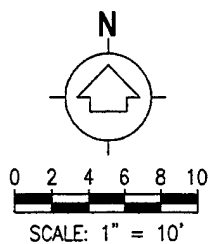
The Outdoor Wash Racks are two concrete facilities that are used by VHFS personnel to clean their vehicles. They were constructed in April 1982 to replace two wash racks that previously were located near the area, in the middle of what is now a parking area. Each wash rack has 10-inch concrete berms to prevent runoff and a ramped entrance to prevent run-on. Drains from the existing racks lead to a grit chamber, which discharges the effluent to the sanitary sewer. Figure 1-3 shows the layout of the wash racks and the grit chamber. Drains from the previous racks discharged to the surrounding soils.

The grit chamber and adjacent sewage lift station have been saturated with oil due to vehicle maintenance activities performed while on the racks (Reisch 1993). In February 1992, the grit chamber and the sewage lift station were steam cleaned and all fluids and sediments were drummed and removed. The fluids and sediments were removed by DRMO for disposal as hazardous wastes. Samples from the chamber contained 360,000 mg/L of total petroleum hydrocarbons (TPH) with a gas chromatography/mass spectrometry (GC/MS) "fingerprint" for motor oil and gasoline. In addition, small amounts of benzene, toluene, ethylbenzene, and xylene (BTEX); lead; and antifreeze were detected in the fluids and sediments. The wastewater also contained surfactants and phosphorus from cleaning solutions.



**LEGEND:**

	BUILDING
	FENCE
	SURFACE SOIL SAMPLE
	GRASS
	UNDERGROUND PIPE
	ASPHALT



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**AREE 26 - OUTDOOR WASH RACKS  
PLAN VIEW**

Figure: 1-3	Project: 01-0827-03-6521-081	File Name: /95005/DWGS/413WASH	Date: 5-31-96
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The grit chamber was filled with sediment and had an oily sheen with an obvious petroleum odor, as observed during the ENPA site visit. However, the concrete sides of the chamber were in good condition with no cracks or leaks evident. The condition of the bottom of the chamber is unknown. During storm events, oily wastes may be flushed out of the grit chamber to the storm sewer. A dumpster is located nearby, which contained household garbage and empty antifreeze and oil containers at the time of the ENPA site visit.

#### ***1.5.22 AREE 27 - AAFES Service Station***

The Army, Air Force Exchange Service (AAFES) Service Station (Building 238) was constructed in 1969 to provide fuel for VHFS personnel vehicles. Operations at the AAFES Service Station were discontinued in the spring of 1994 and the facility was closed. The service station contained pumps for three grades of gasoline and a service area with two lifts. In addition, a fenced storage area was located in the rear of the facility for tires, batteries, and drums.

Many spills of gasoline and oil have occurred in this area (e.g., a snow plow knocked over a gas pump in March 1993). Oil stains were observed on the asphalt and in the surrounding vegetation in aerial photographs (EPIC 1983). There was also one instance of a battery acid spill in the service bay area. Drains in the pump island area lead to a grit chamber, which discharges to a field north of the facility.

#### ***1.5.23 AREE 28-5 - Former Service Station Abandoned USTs***

The Former Service Station Abandoned USTs were located underneath the former service station (Building 220) parking lot. Prior to the SI, it was believed from available data that two steel tanks were present at this location. However, subsequent excavation activities conducted in December 1994 by VHFS revealed that three tanks were present at this AREE. The tanks were in service until 1983 and had contained an unknown quantity of gasoline and/or diesel fuel. Previous documentation indicated that upon closure, the tanks were emptied of petroleum product and then filled with sand and concrete to the surface. However, during tank excavation activities, it was discovered that the tanks were partially filled with water. The tanks were never

leak tested and the date of installation is unknown. Building 220 was initially constructed in 1925, but the date of its conversion to a service station is unknown.

#### ***1.5.24 AREE 29-1 - Salvage Yard***

The Salvage Yard is listed as site number 3 in the EPIC aerial photographs (EPIC 1983). This site is located in the northwest section of VHFS, near Route 652, across the installation road from the Incinerator (AREE 20). Review of 1974 aerial photographs identified a small fenced salvage yard containing drums and debris. In 1977, the ground in the enclosure was scarred, and two mounds of material were identified inside the area. Review of 1982 aerial photographs showed that the facility had been removed. Neither aerial photographs nor discussions with installation personnel showed evidence indicating that hazardous materials were released in this area. The ENPA site visit conducted in October 1993 did not reveal any signs of salvage yard activity.

#### ***1.5.25 AREE 29-2 - Possible Sludge Disposal Area***

The Possible Sludge Disposal Area is located near the far northernmost boundary of VHFS, near Route 215. Review of 1977 and 1978 EPIC aerial photographs indicated scarred ground and a pile of gray material, possibly sludge, to be present in this area. The ENPA site visit in October 1993 revealed a stand of trees in the area that may be 10 to 15 years old. The ground within the treed area was extremely uneven, indicating that material previously had been piled on the ground.

#### ***1.5.26 AREE 29-3 - Possible Disposal Area***

The Possible Disposal Area is listed as site number 7 in the EPIC aerial photographs (EPIC 1983). This site is located southeast of the fixed ammunition magazine. The western South Run tributary flows just to the east of the area. Review of 1950 aerial photographs indicated possible disposal activities due to ground scarring and the presence of mounds of material and possible equipment. Review of 1958 photographs indicated that the area was revegetating and the ammunition storage building had been constructed nearby. The aerial photography review primarily notes ground scarring as the basis for classification of this area

as a possible disposal area. Evidence from the review suggests that the mounded materials present in this area are soil. Neither aerial photographs nor discussions with installation personnel showed evidence indicating that hazardous materials were released in this area. The ENPA site visit revealed no evidence of dumping; however, small persistent areas of ground scarring exist.

#### ***1.5.27 AREE 29-4 - Disposal Area***

The Disposal Area is located near the northeast corner of VHFS, northwest of the Skeet Range (AREE 14). Review of EPIC aerial photographs of this area showed signs of disposal activities as early as 1958. These signs were visible to various extents as late as 1977. By 1982, the area was grass covered with the exception of two groves of trees at the end of the site. A total of five distinct areas are located within the Disposal Area. Two areas were used for construction debris disposal and are now enclosed within groves of mature trees. Another area is an approximately 30-foot wide man-made depression in the ground where water collects after rain events. It is not known whether the area was used to obtain fill material or for liquid disposal. The last two areas were an orange mound area and an orange/brown stain area that are both currently level and covered with grass. It is not known what materials were stored in these areas.

### **1.6 ENVIRONMENTAL AND REGIONAL SETTING**

The following sections provide information regarding the demographics, land use, climate, meteorology, hydrology, physiography, geology, hydrogeology, and sensitive environments in the vicinity of VHFS.

#### ***1.6.1 Demographics and Land Use***

Approximately 7,000 people live within 4 miles of VHFS (Weston 1990). In addition, there are 244 Family Housing Units (FHUs) and a number of barracks for enlisted personnel at VHFS. The residential population is 400. Land use in the immediate vicinity of VHFS is primarily agricultural (mostly horse farms) and residential areas. With the exception of a few residences to the north, the majority of residential development is located south of VHFS. A

small county recreation park is located adjacent to VHFS along South Run. Other land uses that are more commercial and industrial are located closer to the population centers of Warrenton to the southwest and Manassas to the east. According to U.S. Bureau of the Census data, the population in these centers and in Fauquier County has been increasing, as shown in Table 1-2. Public access areas at Lake Brittle and Lake Manassas are within 1 mile of VHFS (ESE 1986).

**Table 1-2. Fauquier County Census Data**

Census Designated Area	1980 Census	1990 Census
Warrenton	3,907	4,830
Manassas	15,438	27,957
Manassas Park	6,524	6,734
Fauquier County	35,889	48,741

Sources: Rand McNally 1986 and 1992.

### ***1.6.2 Climate and Meteorology***

The climatic conditions at VHFS are variable, with influences from the Atlantic Ocean to the east and the Appalachian Mountains to the west. Summers are characterized by maritime-tropical winds from the south and southwest, which bring warm, humid air to the region. High-pressure systems often stagnate over the area, creating air pollution episodes several times during the summer. Winter is characterized by cold, dry, continental polar winds from the northwest.

Average temperature at VHFS varies from a monthly low of 1.5°C in January to a mean monthly high of 24.3°C in August. The average annual rainfall is 104.8 cm, while snowfall averages 61 cm annually.

### ***1.6.3 Hydrology and Physiography***

The following sections discuss the hydrology, physiography, and soil distributions in the vicinity of VHFS.

#### **1.6.3.1 Hydrology**

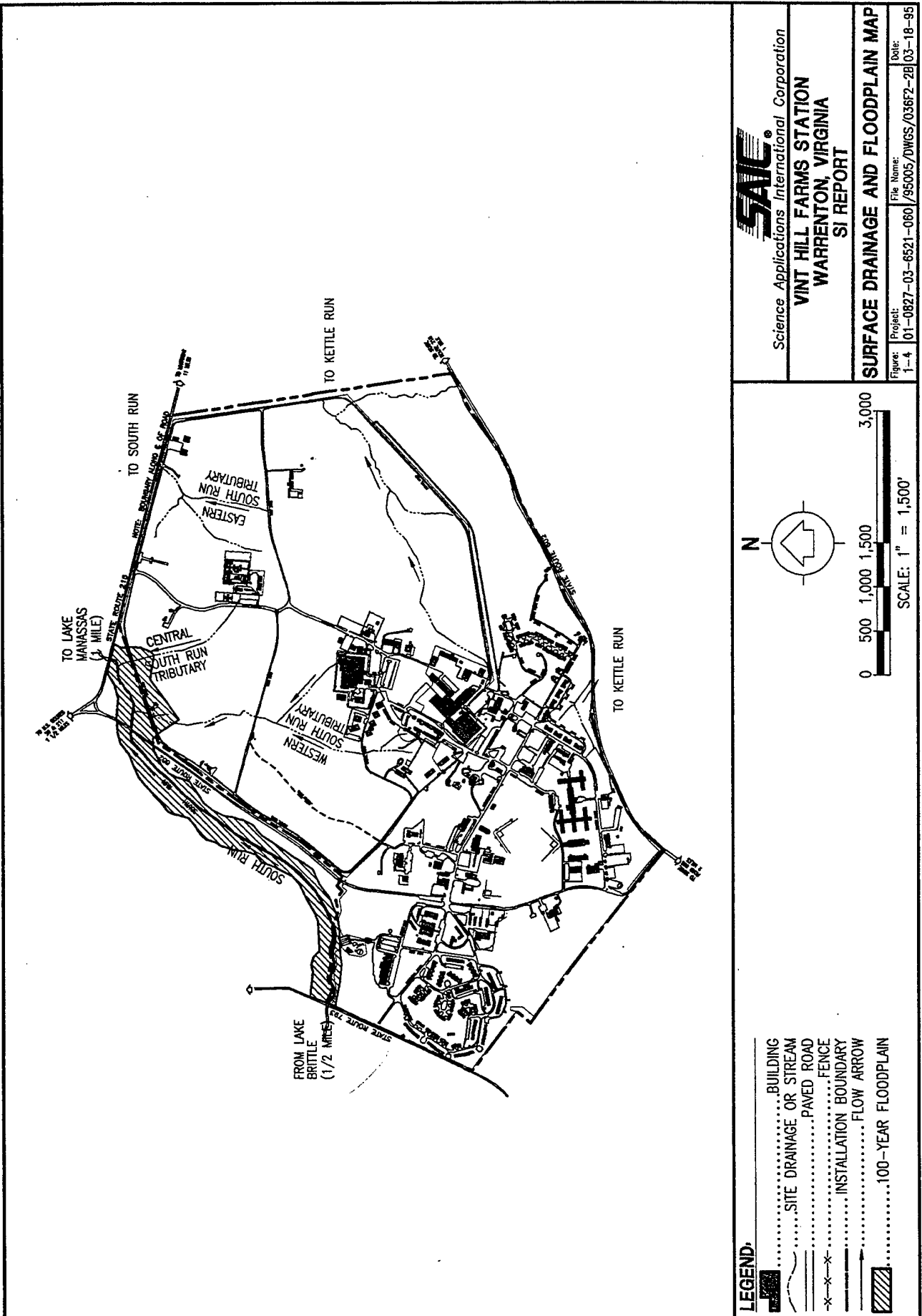
VHFS is located in the Occoquan watershed. Most of the facility drains to South Run via intermittent tributaries and drainage ditches, as shown in Figure 1-4. South Run is a small Class III Virginia stream that begins in Fauquier County and flows northeast into Prince William County where it discharges into Lake Manassas, a recreation and drinking water reservoir built on Broad Run for the city of Manassas.

The upper reaches of South Run were inundated by the construction of the Lake Brittle reservoir, whose dam lies approximately ½ mile west of VHFS. The dam controls the flow into South Run, which can be quite low, as seen during the ENPA site visit conducted in September 1993. The installation has a permit (VPDES permit VA0020460) to discharge effluent from the STP into South Run. The STP (AREE 2) adds approximately 220,000 gallons per day (GPD) to the natural stream flow of 4,900,000 GPD.

Drainage for the southern part of the installation flows south and east to Kettle Run, as shown in Figure 1-4. Kettle Run eventually joins Broad Run approximately 10 miles downstream from Lake Manassas.

#### **1.6.3.2 Physiography**

VHFS is located near the border between the Coastal Plain and Piedmont Physiographic Provinces in Virginia. Locally, the topography suggests that VHFS is at the edge of the Piedmont, in the Culpeper Basin of Triassic Age (195 to 230 million years ago). The basin is characterized by rolling terrain with moderate to thin residual soil cover above structurally complex rock strata consisting of folded layers of sedimentary and metamorphic rocks containing zones of igneous intrusion (ESE 1986). Local topography at VHFS consists of gently rolling hills with slopes generally less than 10 percent. Elevations on the installation vary from 335 to 430 feet above mean sea level (msl).



### 1.6.3.3 Soils

The two major soil associations in the VHFS vicinity are the Montalto and Penn-Croton-Bucks associations, as determined by the 1956 U.S. Department of Agriculture (USDA) Soil Survey of Fauquier County, Virginia. The Montalto soil association has developed predominantly on undulating land from fine-grained Triassic diabase. The moderately shallow phase of Montalto soils is the predominant soil series in the VHFS vicinity. However, smaller areas of Elbert, Zion, Iredell, and recent colluvial and alluvial soils occur (USDA 1956). The Montalto unit is best suited for agricultural and woodland uses. High coarse fragment content and depth to rock are typical limiting factors of this unit. The characteristics of the Montalto association are described in greater detail below:

- ***Elbert Series***—The soils of the Elbert series are very deep and poorly drained gray clayey soils. They formed on flat depressed upland and along small drainage ways and developed in residuum from fine-grained Triassic diabase. The soils are considered to be hydric with high water tables. Slopes range from 0 to 2 percent.
- ***Iredell Series***—The soils of the Iredell series are very deep and poorly to moderately well-drained yellowish brown to olive brown claypan soils with perched seasonal water table on convex ridges. They were developed in residuum from Triassic diabase. They may have hydric soil inclusions. Slopes range from 0 to 7 percent.
- ***Zion Series***—The soils of the Zion series are moderately deep and somewhat poorly drained yellowish-brown clayey soils. They formed on gently sloping concave uplands and developed in residuum from coarse-grained Triassic diabase. They may have hydric soil inclusions. Slopes range from 2 to 7 percent.

The Penn-Croton-Bucks unit is the most common in Fauquier County (over 19 percent of the county) and contains the greatest number of soils. It occurs in the Culpeper basin and is underlain by shale and sandstone. The Penn soils are the predominant soils in the association. The Croton, Kelly, Wadesboro, Calverton, and Bucks soils are less extensive and make up an important part of the association. Minor areas of Catlett soils occur in the uplands, terrace, and first bottom soils along the streams. The soils of the association are evenly distributed throughout the county, with the exception of the Wadesboro, which is mostly found near Greenville. The Penn-Croton-Bucks unit is well-suited for most agricultural uses. The major use limitations with this soil association are depth to bedrock, droughtiness, and seasonal water

tables. The characteristics of Penn-Croton-Bucks association soils are described in greater detail below:

- ***Penn Series***—The soils of the Penn series are shallow to moderately deep and well to excessively well-drained, reddish-brown loamy to silty soils. They developed in residuum from Triassic siltstone, shale, and fine-grained sandstone. Slopes range from 0 to 25 percent.
- ***Croton Series***—The soils of the Croton series are deep and poorly drained, mottled yellowish-brown and gray clayey soils with seasonal perched water tables in concave landscapes (swales) and drainageways. They developed in local alluvium washed from Triassic uplands. They are considered to be hydric. Slopes range from 0 to 5 percent.
- ***Kelly Series***—The soils of the Kelly series are deep and moderately well to poorly drained, gray and grayish-brown claypan soils with seasonal perched water tables on gently sloping concave uplands. They developed in local wash and residuum from thermally altered Triassic shale. They may have hydric soil inclusions. Slopes range from 0 to 7 percent.
- ***Wadesboro Series***—The soils of the Wadesboro series are deep and well-drained, red to dark-red loamy soils on sideslopes. They developed in residuum from Triassic siltstone, shale, sandstone, and conglomerate. Slopes range from 7 to 14 percent.
- ***Calverton Series***—The soils of the Calverton series are moderately deep and somewhat poorly drained, yellowish-brown mottled with gray clayey soils with seasonal perched water tables. They developed in local colluvium and residuum from red Triassic shale and sandstone. They may have hydric soil inclusions. Slopes range from 2 to 7 percent.
- ***Bucks Series***—The soils of the Bucks series are deep and well-drained dark reddish-brown silty soils. They formed on broad gently sloping ridges and developed in residuum from red Triassic shale and sandstone. Slopes range from 2 to 7 percent.
- ***Catlett Series***—The soils of the Catlett series are shallow and moderately well-drained, grayish brown silty soils containing more than 35 percent rock fragments. They formed on gently sloping sideslopes and developed in residuum from bluish-gray thermally altered Triassic shale. Slopes range from 2 to 7 percent.

#### **1.6.4 Sensitive Environments**

No plant or wildlife species listed by the U.S. Fish and Wildlife Service (USFWS) or the Commonwealth of Virginia Endangered Species Act as threatened or endangered are known to occur at VHFS. The southern bald eagle (*Haliaeetus leucocephalus*), an endangered species, is occasionally observed at nearby Lake Manassas. Approximately 5 acres of VHFS property are



within the 100-year floodplain of South Run, as shown in Figure 1-4. Dump #1 (AREE 1) and the Pistol Range (AREE 19) are within the floodplain. The western South Run tributary is considered a palustrine wetland and is the only wetland on the VHFS property (USDOI 1977). Approximately 20 acres of wetlands are within a 4-mile radius of the property.

## **2. FIELD PROGRAM**

Initial field activities for the Vint Hill Farms Station (VHFS) Site Inspection (SI) were conducted between September and November 1994. Additional field activities were conducted during May and June 1995. Prior to initiating the field program, sample and boring locations were staked by Science Applications International Corporation (SAIC) and utilities were cleared by VHFS personnel. Inspection activities conducted by SAIC at VHFS included geophysical surveys, field screening, soil organic vapor (SOV) surveys, subsurface borings, soil sampling, sediment sampling, groundwater probe installation, monitoring well installation, groundwater sampling, surface water sampling, wipe sampling, test pit excavation, topographic surveying, and a sewerline video survey. The field activities conducted at each of the areas requiring environmental evaluation (AREEs) are summarized in Table 2-1.

### **2.1 FIELD ACTIVITY SUMMARY**

Special methods were used to evaluate sites where the subsurface environment was not specifically known. Geophysical methods (i.e., electromagnetics [EM] and magnetics) were used to delineate the tanks at the Former Service Station Abandoned Underground Storage Tanks (USTs) (AREE 28-5) and to search for buried materials at the Salvage Yard (AREE 29-1) and Possible Disposal Area (AREE 29-3). SOV surveys were used to characterize source areas from Dump #1 (AREE 1), Sugar Tree (AREE 25), and the Former Service Station Abandoned USTs. Remote-controlled videocameras were used to evaluate the condition of the Environmental Photographic Interpretation Center (EPIC) Building (AREE 5) industrial sewerline.

Soil samples collected from the Transformer Storage Area (AREE 24) and from the seven suspected leaking transformer sites were field screened for polychlorinated biphenyl (PCB) content.

Groundwater samples were collected from existing monitoring wells downgradient from AREEs that have potential subsurface contamination (i.e., Dump #1 [AREE 1], EPIC Building [AREE 5] industrial sewerline, Former Photographic Wastewater Lagoon [AREE 10], Skeet Range [AREE 14], Dump #3 [AREE 17], Sand Filter Beds [AREE 21], and Possible Sludge

**Table 2-1. Summary of Site Inspection Field Activities  
Vint Hill Farms Station, Warrenton, Virginia**

AREE No.	AREE Name	Site Inspection Activities	Chemical Analyses Conducted	Modifications to Work Plan
1	Dump #1	<ul style="list-style-type: none"> <li>• SOV survey (47 sample points)</li> <li>• 1 groundwater probe installed</li> <li>• 1 surface water sample</li> <li>• 4 groundwater samples (3 from existing wells, 1 from probe)</li> </ul>	Metals SVOCs VOCs TPH Pesticides/PCBs Cyanide	Used a reduced grid for the SOV survey due to encroachment of tree line
2	Sewage Treatment Plant	<ul style="list-style-type: none"> <li>• 2 surface soil borings</li> <li>• 2 soil samples (1 from each borehole)</li> </ul>	Metals SVOCs Cyanide	None
3	Warehouse	<ul style="list-style-type: none"> <li>• 2 push borings</li> <li>• 2 soil borings</li> <li>• 4 soil samples (1 from each borehole)</li> </ul>	Metals SVOCs (soil borings only) VOCs TPH (push borings only)	Did not obtain one push boring due to access problems within the Warehouse
4	Auto Craft Shop	<ul style="list-style-type: none"> <li>• 4 surface soil borings</li> <li>• 4 soil samples (1 from each borehole)</li> </ul>	Metals SVOCs VOCs TPH	None
5	EPIC Building	<ul style="list-style-type: none"> <li>• remote video survey of sewerline</li> <li>• 6 soil borings</li> <li>• 6 soil samples (1 from each borehole)</li> <li>• 1 groundwater sample (from existing well)</li> </ul>	Metals SVOCs VOCs Cyanide	None
7	Electrical Equipment Facility Pretreatment Tank	<ul style="list-style-type: none"> <li>• 2 soil borings</li> <li>• 2 soil samples (1 from each borehole)</li> </ul>	Metals SVOCs VOCs Cyanide	None

Metals: Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn  
 Anions: Cl, NO<sub>3</sub>, NO<sub>2</sub>, PO<sub>4</sub>, SO<sub>4</sub>, Br, F  
 Soil parameters: redox potential, pH, organic content, grain size, Atterberg limits, and percent moisture

**Table 2-1. Summary of Site Inspection Field Activities  
Vint Hill Farms Station, Warrenton, Virginia (continued)**

AREE No.	AREE Name	Site Inspection Activities	Chemical Analyses Conducted	Modifications to Work Plan
9	Vehicle Maintenance Area	<ul style="list-style-type: none"> <li>1 soil boring</li> <li>1 soil sample (1 from each borehole)</li> <li>1 surface water sample</li> <li>1 sediment sample</li> </ul>	Metals SVOCs VOCs TPH Pesticides/PCBs Herbicides	Did not obtain 1 soil boring due to concrete bottom found in 1 neutralization pit
10	Former Photographic Wastewater Lagoon	<ul style="list-style-type: none"> <li>3 soil borings</li> <li>3 soil samples (1 from each borehole)</li> <li>1 groundwater sample (from existing well)</li> </ul>	Metals Cyanide Anions (groundwater only)	Could not drill 1 soil boring due to access problems on the muddy terrain
11	Former Sewage Treatment Plant	<ul style="list-style-type: none"> <li>4 surface soil borings</li> <li>4 soil samples (1 from each borehole)</li> </ul>	Metals SVOCs Cyanide	None
12	Dump #2	<ul style="list-style-type: none"> <li>5 groundwater probes installed</li> <li>3 groundwater monitoring wells installed</li> <li>4 groundwater samples (3 from wells and 1 from probe)</li> <li>1 slug test (on installed well)</li> </ul>	Metals SVOCs VOCs	Could not sample 4 probes due to absence of groundwater; could not obtain SVOC and metals analyses at probe due to low yield
13	Sludge Disposal Area	<ul style="list-style-type: none"> <li>4 soil borings</li> <li>4 soil samples (1 from each borehole)</li> </ul>	Metals Cyanide	None
14	Skeet Range	<ul style="list-style-type: none"> <li>10 surface soil borings</li> <li>10 soil samples (1 from each borehole)</li> <li>1 groundwater sample (from existing well)</li> </ul>	Total Lead Organic Lead Soil Parameters	None

Metals: Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Ti, V, Zn  
 Anions: Cl, NO<sub>3</sub>, NO<sub>2</sub>, PO<sub>4</sub>, SO<sub>4</sub>, Br, F  
 Soil parameters: redox potential, pH, organic content, grain size, Atterberg limits, and percent moisture

**Table 2-1. Summary of Site Inspection Field Activities  
Vint Hill Farms Station, Warrenton, Virginia (continued)**

AREE No.	AREE Name	Site Inspection Activities	Chemical Analyses Conducted	Modifications to Work Plan
16	Firefighter Training Pit	<ul style="list-style-type: none"> <li>• 4 surface soil borings</li> <li>• 4 soil samples (1 from each borehole)</li> </ul>	Metals SVOCs VOCs TPH	None
17	Dump #3	<ul style="list-style-type: none"> <li>• 4 groundwater probes installed</li> <li>• 3 groundwater monitoring wells installed</li> <li>• 4 groundwater samples (3 from installed wells and 1 from existing well)</li> <li>• 1 slug test (on installed well)</li> </ul>	Metals SVOCs VOCs Pesticides/PCBs	Could not sample any of the probes due to absence of groundwater
18	Grease Pit	<ul style="list-style-type: none"> <li>• 2 soil borings</li> <li>• 2 soil samples (1 from each borehole)</li> </ul>	Metals TPH (Method 8015)	None
19	Pistol Range	<ul style="list-style-type: none"> <li>• 3 surface soil borings</li> <li>• 3 soil samples (1 from each borehole)</li> <li>• 2 sediment samples</li> </ul>	Total Lead Organic Lead Soil Parameters	None
20	Incinerator	<ul style="list-style-type: none"> <li>• 2 soil borings</li> <li>• 2 soil samples (1 from each borehole)</li> </ul>	Metals SVOCs VOCs Pesticides/PCBs	None
21	Sand Filter Beds	<ul style="list-style-type: none"> <li>• 7 surface soil borings</li> <li>• 7 soil samples (1 from each borehole)</li> <li>• 3 groundwater probes installed</li> <li>• 3 groundwater monitoring wells installed</li> <li>• 6 groundwater samples (3 from installed wells, 2 from probes, 1 from existing well)</li> <li>• 1 slug test (on installed well)</li> </ul>	Metals Dioxins (at 4 soil samples within sand filter beds only)	Could not sample 1 probe due to absence of groundwater

Metals: Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn  
 Anions: Cl, NO<sub>3</sub>, NO<sub>2</sub>, PO<sub>4</sub>, SO<sub>4</sub>, Br, F  
 Soil parameters: redox potential, pH, organic content, grain size, Atterberg limits, and percent moisture

**Table 2-1. Summary of Site Inspection Field Activities  
Vint Hill Farms Station, Warrenton, Virginia (continued)**

AREE No.	AREE Name	Site Inspection Activities	Chemical Analyses Conducted	Modifications to Work Plan
24	Transformer Storage Area	<ul style="list-style-type: none"> <li>6 surface soil borings</li> <li>PCB screening</li> <li>2 soil samples (from 2 of the soil borings)</li> </ul>	Metals TPH Pesticides/PCBs	None
25	Sugar Tree	<ul style="list-style-type: none"> <li>SOV survey (49 sample points during initial survey, 14 points during supplemental survey)</li> <li>1 surface soil boring</li> <li>1 soil sample</li> </ul>	TPH (Method 8015)	None
26	Outdoor Wash Racks	<ul style="list-style-type: none"> <li>6 surface soil borings</li> <li>6 soil samples (1 from each boring)</li> </ul>	Metals SVOCs VOCs TPH	None
27	AAFES Service Station	<ul style="list-style-type: none"> <li>3 surface soil samples</li> <li>3 soil samples (1 from each boring)</li> </ul>	Metals SVOCs VOCs TPH	None
28-5	Former Service Station Abandoned USTs	<ul style="list-style-type: none"> <li>geophysical survey (EM and magnetometer)</li> <li>SOV survey (30 soil gas samples and 40 soil samples) screened for VOCs</li> <li>4 soil borings</li> <li>4 soil samples (1 from each boring)</li> </ul>	SVOCs VOCs TPH Total Lead	None
29-1	Salvage Yard	<ul style="list-style-type: none"> <li>geophysical survey (EM and magnetometer)</li> <li>7 test pits</li> </ul>	Metals SVOCs VOCs	Did not collect the 2 scheduled soil samples because no evidence of potential contamination was found in the test pits

Metals: Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn

Anions: Cl, NO<sub>3</sub>, NO<sub>2</sub>, PO<sub>4</sub>, SO<sub>4</sub>, Br, F

Soil parameters: redox potential, pH, organic content, grain size, Atterberg limits, and percent moisture

**Table 2-1. Summary of Site Inspection Field Activities  
Vint Hill Farms Station, Warrenton, Virginia (continued)**

AREE No.	AREE Name	Site Inspection Activities	Chemical Analyses Conducted	Modifications to Work Plan
29-2	Possible Sludge Disposal Area	<ul style="list-style-type: none"> <li>2 surface soil borings</li> <li>2 soil samples (1 from each boring)</li> <li>3 groundwater probes installed</li> <li>3 groundwater monitoring wells installed</li> <li>6 groundwater samples (3 from installed wells, 2 from probes, 1 from existing well)</li> <li>1 slug test (on installed well)</li> </ul>	Metals SVOCs VOCs Cyanide	Could not sample 1 probe due to absence of groundwater
29-3	Possible Disposal Area	<ul style="list-style-type: none"> <li>geophysical survey (EM and magnetometer)</li> </ul>	None	None
29-4	Disposal Area	<ul style="list-style-type: none"> <li>3 surface soil borings</li> <li>3 soil samples (1 from each boring)</li> <li>5 groundwater probes installed</li> <li>3 groundwater monitoring wells installed</li> <li>6 groundwater samples (3 from installed wells, 3 from probes)</li> <li>1 slug test (on installed well)</li> </ul>	Metals SVOCs VOCs Pesticides/PCBs	Could not sample 2 probes due to absence of groundwater
---	Background	<ul style="list-style-type: none"> <li>3 soil borings</li> <li>5 soil samples</li> <li>1 groundwater sample (from existing well)</li> </ul>	Metals SVOCs Cyanide VOCs TPH (by Methods 8015 and 418.1) Pesticides/PCBs Anions (groundwater only) Herbicides Dioxin (soil only) Organic Lead Soil Parameters	Could not obtain the second soil sample from 1 boring due to presence of bedrock

Metals: Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn  
Anions: Cl, NO<sub>3</sub>, NO<sub>2</sub>, PO<sub>4</sub>, SO<sub>4</sub>, Br, F  
Soil parameters: redox potential, pH, organic content, grain size, Atterberg limits, and percent moisture

**Table 2-1. Summary of Site Inspection Field Activities  
Vint Hill Farms Station, Warrenton, Virginia (continued)**

AREE No.	AREE Name	Site Inspection Activities	Chemical Analyses Conducted	Modifications to Work Plan
---	Other Areas	<ul style="list-style-type: none"> <li>• 2 wipe samples at former pesticide/herbicide storage areas</li> <li>• 7 surface soil samples screened for PCBs at suspected leaking transformer areas</li> </ul>	Pesticides Herbicides PCBs	None

Metals: Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn  
 Anions: Cl, NO<sub>3</sub>, NO<sub>2</sub>, PO<sub>4</sub>, SO<sub>4</sub>, Br, F  
 Soil parameters: redox potential, pH, organic content, grain size, Atterberg limits, and percent moisture



Disposal Area [AREE 29-2]). These wells were installed by Environmental Science and Engineering (ESE) in 1984. Groundwater probes were installed downgradient from Dump #1 (AREE 1), Dump #2 (AREE 12), Dump #3 (AREE 17), the Sand Filter Beds (AREE 21), the Possible Sludge Disposal Area (AREE 29-2), and the Disposal Area (AREE 29-4) to determine if groundwater contamination exists at these sites. However, due to the absence of groundwater in some of the probes, groundwater samples were obtained only at 9 of the 21 probes installed.

Monitoring wells were installed and sampled at Dump #2 (AREE 12), Dump #3 (AREE 17), the Sand Filter Beds (AREE 21), the Possible Sludge Disposal Area (AREE 29-2), and the Disposal Area (AREE 29-4). Three wells (one upgradient and two downgradient) were installed at each AREE. Slug tests were performed at one well per AREE to obtain hydraulic conductivity information. Groundwater elevations were measured in each newly installed monitoring well to provide local groundwater flow direction at each AREE.

Surface water and/or sediment samples were collected downgradient from three AREEs to determine if migration of contaminants had occurred to nearby surface water bodies. One surface water sample was collected from the tributary that leads to South Run at Dump #1 (AREE 1). Surface water and sediment samples also were collected within the western South Run tributary as part of the investigation for the Vehicle Maintenance Area (AREE 9). In addition, two sediment samples were collected within the impact berm drainage ditch at the Pistol Range (AREE 19).

Subsurface soil borings (i.e., more than 2 feet below land surface [BLS]) were drilled and sampled in areas where subsurface disposal of hazardous materials may have occurred or where migration of contaminants to subsurface soils may have occurred. These areas included the Warehouse (AREE 3), EPIC Building (AREE 5) industrial sewerline, Electrical Equipment Facility (AREE 7) Pretreatment Tank, Vehicle Maintenance Area (AREE 9), Former Photographic Wastewater Lagoon (AREE 10), Sludge Disposal Area (AREE 13), Grease Pit (AREE 18), Incinerator (AREE 20), and Former Service Station Abandoned USTs (AREE 28-5). A total of 30 subsurface soil borings were completed, 28 by auger rig drilling and 2 by hydraulic push equipment.

Surface soil borings (i.e., less than 2 feet BLS) were drilled and sampled in areas where hazardous materials were stored directly on the ground surface or spills of hazardous materials may have occurred. These areas included the Sewage Treatment Plant (STP) (AREE 2), Auto Craft Shop (AREE 4), Former STP (AREE 11), Skeet Range (AREE 14), Firefighter Training Pit (AREE 16), Pistol Range (AREE 19), Sand Filter Beds (AREE 21), Transformer Storage Area (AREE 24), Sugar Tree (AREE 25), Outdoor Wash Racks (AREE 26), Army, Air Force Exchange Service (AAFES) Service Station (AREE 27), Possible Sludge Disposal Area (AREE 29-2), and Disposal Area (AREE 29-4). A total of 50 surface soil samples were collected using a core sampler filled with stainless steel and brass sleeves and/or a stainless steel trowel.

The historical use of Building 253 (a storage shed within the engineering compound) and Building 320 (a maintenance building within the housing area) included the storage of pesticides and herbicides. Wipe samples were collected from the walls of both buildings and analyzed for pesticides and herbicides to determine if residual pesticide or herbicide contaminants remained in the buildings.

Test pits were excavated at the Salvage Yard (AREE 29-1) in two areas where anomalies were observed from the geophysical surveys. Three test pits were excavated in one anomalous area and four test pits were excavated in the second area to determine if drums or tanks were buried or other potentially hazardous materials were present.

The target compounds of concern were specific to each AREE and were selected based on the type of known material or waste handling practices that occurred at the AREE. For example, historical records indicated that Dump #1 (AREE 1) received a variety of materials and wastes, including household garbage, organic solvents, and waste oil. Therefore, target compounds for Dump #1 samples included volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, pesticides, PCBs, total petroleum hydrocarbons (TPH), and cyanide. In contrast, historical records on the Former STP (AREE 11) indicated that the plant contained only sewage sludge; SVOCs, metals, and cyanide were selected as the target compounds for samples collected from this AREE.

Background samples of soil and groundwater were obtained from areas that appeared to be uncontaminated and were upgradient of the AREEs. Sampling results provided the basis to compare data from the other AREEs. The soil samples were collected from three soil borings drilled in the southern portion of the facility within each of the three major surficial geologic zones. The groundwater samples were collected from an existing groundwater monitoring well that was used previously for background samples.

Topographic surveying was completed for the groundwater probes and wells installed at Dump #1 (AREE 1), Dump #2 (AREE 12), Dump #3 (AREE 17), Sand Filter Beds (AREE 21), Possible Sludge Disposal Area (AREE 29-2), and Disposal Area (AREE 29-4). Horizontal locations were determined in North America Data (NAD) 1927 Virginia State Plane Coordinates and vertical elevations of the ground surface were obtained to calculate the local groundwater flow direction. Land surveying also was completed along geophysical and/or SOV survey transects at the Salvage Yard (AREE 29-1), Possible Disposal Area (AREE 29-3), Sugar Tree (AREE 25), and Former Service Station Abandoned USTs (AREE 28-5). Topographic surveying was used to determine the placement of groundwater probes and geophysical and SOV grids on the existing VHFS base map. However, because the VHFS coordinates were not accurately surveyed, visual evidence was used to adjust the probe and grid placement.

All field activities were documented in the sampling and boring forms, and in the field logbooks (#1 through #7). These documents are part of the permanent project record.

## **2.2 FIELD ACTIVITIES AND PROCEDURES**

This section describes the activities used to qualitatively and quantitatively assess the presence of contamination at the sites. Qualitative activities included the geophysical surveys, field screening, SOV surveys, and sewerline video survey. Quantitative activities included the surface and subsurface soil sampling, groundwater sampling of monitoring wells and probes, surface water sampling, sediment sampling, and wipe sampling. The techniques and procedures used during the SI are described below, and the results and interpretations are provided in Section 3.

### **2.2.1 Geophysical Surveys**

Geophysical surveys were conducted at the Former Service Station Abandoned USTs (AREE 28-5), Salvage Yard (AREE 29-1), and Possible Disposal Area (AREE 29-3). The surveys were performed to geophysically characterize the source areas within the sites and to provide guidance for selecting locations for drilling soil borings. EM and magnetometer surveys were selected as the most field expedient techniques for source characterization at these three AREEs because of their effectiveness in clayey soils and their ability to delineate subsurface metallic anomalies. The results of the geophysical surveys are provided in Appendix A.

#### **2.2.1.1 Electromagnetic Survey**

Before the EM survey began, a grid was superimposed over each measurement area. The transect lines at the three AREEs were land surveyed to ensure that the data were accurately located with respect to site features. The stations were marked with orange paint on the paved area and wooden hubs or flags in the grassy area at a designated interval of 10 feet at the Former Service Station Abandoned USTs (AREE 28-5), 10 feet at the Salvage Yard (AREE 29-1), and 25 feet at the Possible Disposal Area (AREE 29-3).

All frequency domain EM measurements were made using a Geonics EM31-DL ground conductivity meter and data were recorded with an Omnidata data logger. The meter consisted of a transmitter and receiver coils with a 12-foot intercoil spacing. The instrument has an optimal depth of investigation of approximately 20 feet when operated in the vertical dipole mode. Both the quadrature-phase and in-phase components of an induced magnetic field were measured. The quadrature-phase component is a measurement of apparent ground conductivity, while the in-phase component is a measurement of the presence of metal. Apparent ground conductivity was measured with a precision of approximately  $\pm 2$  percent of the full-scale meter reading, which corresponded to approximately 2 millimhos per meter (mmhos/m) for the surveys conducted.

A base station was established at each of the three areas in order to calibrate the meter and check the calibration prior to the survey. To assess repeatability among data, one to two readings were repeated at each location. A total of approximately 10 percent of the data set was

recollected as a quality assurance/quality control (QA/QC) measure. Typically, values of apparent conductivity agreed to within 2 mmhos/m; values of in-phase conductivity agreed to at least 3 parts per thousand (ppt). All pertinent readings and observations were recorded in a bound field notebook.

Data were collected by setting the instrument to record manually. Readings were taken at staked intervals or between stakes, depending upon the resolution required at each site. In general, readings were collected every 10 to 25 feet along a given profile. Both apparent ground conductivity (i.e., quadrature-phase) and in-phase data were recorded in both the vertical and horizontal dipole mode. The operator aligned himself along a profile and collected measurements at marked stations; this procedure resulted in an overall precision in distance greater than 0.5 feet.

Data were transferred from the data logger to diskettes each day using a portable computer. The data were processed using DAT31 software and plotted using Grapher for Windows™ and Surfer for Windows™ software. The raw data, profile plots, and contour plots are presented in Appendix A.

#### **2.2.1.2 Magnetometer Survey**

Total field and vertical gradient magnetic readings were collected every 10 to 25 feet using the grids established for the EM survey. The station density enabled rapid reconnaissance while providing sufficient detail to detect relatively small magnetic features (i.e., on the order of 5 to 10 feet or the distance between two stations) and to complement the in-phase data collected during the EM survey.

All field data were recorded using a Geometrics G-856AX proton precession magnetometer. The instrument included two sensors mounted on an 8-foot pole. The sensors were connected to a unit that displayed and stored the data. The instrument measured the vertical gradient and total field values to an accuracy and precision of approximately 1 and 0.1 nanoTeslas (nT), respectively.

A base station was established at each of the three AREEs to measure diurnal variations during magnetic surveying. Base station data were recorded using the same instrument as described in the previous paragraph with the exception that only one sensor was used to record the total magnetic field. The base station monitored diurnal variations of the total geomagnetic field at 2-minute intervals while the field data were collected. During the course of surveying, the maximum overall diurnal variation was less than 15 nT. Internal clocks on the base station and field magnetometers were synchronized to facilitate data reduction.

At the beginning of each field day, the operator removed all metallic objects from his person. Readings of vertical gradient and total field were collected at individual stations. The readings, time, and station locations were stored internally in the field magnetometer; readings, time, and station identification information also were recorded in a bound field notebook. To check repeatability between data sets, a site was reoccupied at the beginning and end of each survey. The repeatability between all data sets was to within several nT.

Data were transferred from the magnetometers to diskettes each day using a portable computer. The raw data were processed using software packages designed for magnetic processing (i.e., MAGLOC™). Diurnal variations were removed from the top sensor readings and ASCII files were created. Three files were used to create profile plots and contour plots. The bottom or lower sensor values were subtracted from the top or higher sensor values yielding vertical magnetic gradient data. The data were plotted using Grapher for Windows™ and Surfer for Windows™ software. The raw data and profile plots are presented in Appendix A.

### **2.2.2 Test Pits**

The geophysical survey conducted at the Salvage Yard (AREE 29-1) detected two magnetic anomalies: Area 1 (20 by 10 feet) at the north-central edge and Area 2 (10 by 10 feet) at the southwest corner. Four test pits were excavated in Area 1 and three test pits were excavated in Area 2 using a backhoe. Each test pit was approximately 2 feet wide, 10 feet long, and 3 feet deep. Because there was no visual or photoionization detector (PID) evidence of contamination and only inert debris was found in the test pits, the two soil samples planned for

this area was not collected. Test pit logs for the Salvage Yard are presented with the boring logs in Appendix D.

### ***2.2.3 Sewerline Video Survey***

The interior of the 2,700-foot EPIC Building (AREE 5) sewerline was inspected by closed-circuit television to reveal locations of cracks and other points where leakage would most likely occur. These points would determine the placement of the soil borings. The EPIC sewerline is shown in Figure 2-1 and the results of the video survey are provided in Appendix B.

Prior to commencement of the video survey, several manholes had to be located and uncovered. Manhole 1-3 was buried approximately 2 feet under the natural ground surface and required the use of a backhoe for access. Manholes 3-3 and 4-3 were buried approximately 4 to 6 inches under dirt and gravel, respectively, and were uncovered with shovels. Manhole 2-3 was covered by Building 168, which was expanded after the abandonment of the EPIC sewerline (AREE 5), and manhole 7-3 was buried under an asphalt parking lot outside the Vehicle Maintenance Area (AREE 9). Access could not be obtained at either of these manholes. According to VHFS utilities personnel, after the sewerline was abandoned in 1983, it was not necessary to maintain access to the manholes.

The video survey was performed by pulling a 6-inch diameter, 2-foot long camera mounted on skids through each line section. The manholes at each end of the line section first were opened, and then a blower was used to suck a plastic bag from one manhole to the other. A light string was attached to the plastic bag, and this string was then used to pull a steel cable through the line section. This steel cable was subsequently connected to the camera and used to pull the camera through the line section. The results of the survey for each line section are presented in Table 2-2.

All line sections, with the exception of the last 33 feet to the outfall, were constructed of 6-inch diameter vitrified clay pipe with a joint length of 3 feet. All manholes were constructed of brick parged with concrete. The outfall is an 8-inch diameter cast iron pipe extending into the western South Run tributary.





**Table 2-2. Summary of Sewerline Video Survey, Vint Hill Farms Station, Warrenton, Virginia**

Line Section	Length	Comments
1-3 to 2-3 to 3-3	~700 feet	Manhole 2-3 was covered by the Building 168 extension, so survey was tried from 1-3 to 3-3. Could not survey line due to blockage found in line. Tried to force water through line without effect.
3-3 to 4-3	516 feet	Hit blockage midway through line section. Performed reverse setup from 4-3 to 3-3 to complete survey.
4-3 to 5-3	~400 feet	Could not survey line due to blockage. Tried to force water through line without effect. Dye-test indicated that a major break existed in the line.
5-3 to 6-3	496 feet	Surveyed line section without problems.
6-3 to 7-3 to outfall	606 feet	Manhole 7-3 covered by asphalt parking lot, so line was surveyed from 6-3 to the outfall. Blockage found in line at manhole 7-3. Performed reverse setup from outfall to 6-3 to complete survey.

**Definitions**

**Blockage:** A point where the video camera cannot pass. May be caused by a buildup of sludge/material or a pipe collapse.  
**Forcing Water:** Using the 200 pounds per square inch (psi) pressure hose to try to flush out a potential buildup of sludge/material in a line section.  
**Reverse Setup:** Used when a partial blockage prevents the passage of the 6-inch diameter video camera.  
**Dye-Test:** A biodegradable dye introduced to the sewer system to determine if the blockage is partial or complete. The absence of dye appearing in the downstream manhole indicates a complete blockage.

#### **2.2.4 PCB Screening**

Soil samples collected at the Transformer Storage Area (AREE 24) and at the suspected leaking transformer areas (7 locations) were screened for PCBs using D TECH™ PCB Test Kits. These field test kits have a detection limit of 1.0 parts per million (ppm) for Aroclors 1254, 1242, 1248, 1260, 1262, 1268, 1232, 1016, and 1221. The field screening data were used to select the soil samples to be sent to the laboratory for confirmatory PCB analysis.

The principle of operation is based upon a competitive enzyme immunoassay technique. In this method, antibodies specific to the PCB molecules are immobilized on the surface of latex particles. First, approximately 4.5 grams of soil were extracted with methanol to remove any PCBs attached to the soil. The extracted solution was then reacted with an enzyme-conjugate and poured into a collection cup. Finally, a color developing solution was added to the cup to quantify the concentration of PCBs by the intensity of the color development.

At the Transformer Storage Area (AREE 24), the two soil samples with the highest readings from the PCB field screening were planned to be sent to the laboratory for confirmatory analysis. However, no positive PCB readings were detected in any of the samples; therefore, two representative samples were selected. These two samples provide 15 percent confirmatory analysis for the 13 soil samples (6 at AREE 24 and 7 at the transformer areas). At the suspected leaking transformer locations designated in Section 3.6.28 of this report, all soil samples that tested positive for PCBs during the field screening were planned to be sent to the laboratory for confirmatory PCB analysis. However, because no positive PCB readings were detected in any of the samples, no samples were sent to the laboratory.

#### **2.2.5 Soil Organic Vapor Survey**

SOV surveys were conducted at Dump #1 (AREE 1), Sugar Tree (AREE 25), and the Former Service Station Abandoned USTs (AREE 28-5). The objective of the SOV surveys was to screen the surface or subsurface soils for VOCs that may have been released at each site. The results of the surveys are shown in Appendix C.

#### **2.2.5.1 Photoionization Detector Survey**

A PID survey was conducted on the surface soils at the Sugar Tree (AREE 25). The purpose of the PID survey was to determine if VOCs were present in the soils as a result of suspected waste or fuel handling operations at the AREE.

First, a 300- by 250-foot grid was placed over the Sugar Tree (AREE 25) and sampling points were marked at 50-foot centers. After the Sugar Tree was cleared for underground utilities, a stainless steel trowel was used to obtain surface soil samples (from 0 to 6 inches BLS) at the designated grid points. The soil samples were placed in clean glass jars and covered with aluminum foil. After 30 minutes at a warm ambient temperature, the headspace of the jars was sampled with a PID and recorded. A total of 49 soil samples were analyzed in this manner. Approximately 10 percent of the samples (i.e., four samples) also had their headspace extracted with a manual syringe and analyzed by an onsite gas chromatograph (GC) for total VOCs. In addition, four soil samples were collected in an uncontaminated area of VHFS for background readings. The headspace from the four background soil samples was sampled with the PID and two gas samples were sent for analysis by the onsite GC for total VOCs.

During the supplemental survey, an additional 14 surface soil samples were collected near the antenna fields in the southeastern corner of the grid. The headspace of these samples was sampled with the PID in the same manner.

#### **2.2.5.2 Soil Gas Survey**

A soil gas survey was conducted on the subsurface soils at Dump #1 (AREE 1). The purpose of the soil gas survey was to determine if VOCs were present in the soils as a result of disposal operations at Dump #1.

The SOV grid at Dump #1 (AREE 1) was anticipated to be 300 by 300 feet, but due to the encroaching tree line, a reduced grid that was 250 feet at its base and 100 feet at the opposite end (300 feet away) was used. Sampling points were marked at 50-foot centers.

Prior to collecting each soil gas sample, the entire sampling system (including down-hole probe, tubing, syringe, and all associated plumbing) was purged with ambient air drawn through an organic vapor filter cartridge. To collect the soil gas samples, a truck-mounted hydraulic probe was used to advance connected 3-foot sections of 1-inch diameter threaded steel casing down to the sampling depth (5 feet BLS). Once at depth, the casing was hydraulically raised several inches in order to release a disposable drive point and open the bottom of the casing. A Teflon® tube with a perforated hollow stainless steel probe end was inserted into the casing to the bottom of the hole, and threaded through a plug that isolates the bottom-hole sampling chamber from the up-hole annulus. A sample of in situ soil gas was then withdrawn through the probe and used to purge atmospheric air from the sampling system. A second sample of soil gas was withdrawn through the probe and encapsulated in a pre-evacuated glass vial at two atmospheres of pressure (15 pounds per square inch gauge [psig]). The self-sealing vial was detached from the sampling system, packaged, labeled, and stored for laboratory analysis. All sampling holes were backfilled with bentonite and the surface repaired upon completion of the sampling. A total of 47 soil gas samples were collected from Dump #1 (AREE 1).

Prior to each day's field activities, all sampling equipment and probes were decontaminated by washing with an Alconox®/distilled water solution and rinsing thoroughly with distilled water. Internal surfaces were flushed dry using pre-purified nitrogen or filtered ambient air, and external surfaces were wiped clean using clean paper towels.

Each of the soil gas samples and the headspace of the soil samples collected during the field phase of the survey were subjected to dual analyses in the onsite mobile laboratory. One analysis was conducted according to U.S. Environmental Protection Agency (EPA) Method 8010 (modified) on a GC equipped with an electron capture detector (ECD) and using direct injection. Specific analytes standardized for this analysis were bromochloromethane, 1,1,1-trichloroethane, carbon tetrachloride, trichloroethene, and tetrachloroethene.

The second analysis was conducted according to EPA Method 8020 (modified) on a GC equipped with a flame ionization detector (FID) and using direct injection. The analytes selected for standardization in this analysis were benzene, toluene, ethylbenzene, meta- and para-xylene,

and ortho-xylene. Total FID volatiles values were generated by summing the areas of all integrated chromatogram peaks and calculated using the instrument response factor for toluene.

The tabulated results of the laboratory analyses of the soil gas samples were reported in micrograms per liter ( $\mu\text{g/L}$ ) and are provided in Appendix C. In order to provide graphic presentations of the results, selected individual data sets were mapped and contoured to produce the figures in Appendix C.

#### **2.2.5.3 Soil Sample Screening Survey**

A soil sample screening survey was conducted on the subsurface soils at the Former Service Station Abandoned USTs (AREE 28-5). The purpose of the survey was to determine the placement of soil borings in areas suspected of containing soil contamination.

Initially, soil gas samples had been collected from the Former Service Station Abandoned USTs (AREE 28-5). However, these samples were of questionable quality due to insufficient soil gas in the "tight" clay soils at these locations. It was determined that a soil screening survey would be necessary to adequately characterize the site. The soil screening survey differs from the soil gas survey in that in the soil screening survey, soil samples are first collected using the hydraulic pushing equipment. The soil gas is then extracted from the headspace of the soil samples and analyzed in the same manner as the soil gas survey.

The SOV survey at the Former Service Station Abandoned USTs (AREE 28-5) was conducted over the same grid (80 by 80 feet) as the geophysical survey. Sampling points were marked at 10-foot centers. Samples were selected from depths of 6, 9, and/or 12 feet BLS to determine the most contaminated interval.

To collect the soil samples, the hydraulic probe was used to advance a 1-3/8-inch outside diameter (OD) steel sampling tube (equipped with an acetate liner and a piston stop tip) attached to connected 3-foot sections of 1-inch diameter threaded steel casing down to the sampling depth. The piston stop was then released and the pipe driven approximately 2 additional feet, allowing soil to enter the sampling tube. The sampling tube was retrieved, and the liner was removed

from the casing. The ends of the liner were sealed with Teflon®-lined caps, then the liner was packaged and refrigerated pending laboratory analysis. The sampling tube was decontaminated by rinsing with a solution of Alconox® and distilled water and refitted with a new liner prior to reuse. A total of 30 soil samples were collected from the Former Service Station Abandoned USTs (AREE 28-5).

All of the soil samples collected during the field phase of the survey were prepared for analysis according to EPA Method 3810 (modified) by placing 5 grams (g) of the soil sample into a clear 30 mL vial and sealing with a Teflon®-faced butyl rubber septum. The vial was then heated for 10 minutes in a 90° Celsius (C) environment to volatilize hydrocarbons from the soil into the headspace of the sealed vial. The headspaces of the soil samples were then subjected to analyses in the onsite laboratory, as described in Section 2.2.5.2.

#### ***2.2.6 Surface and Subsurface Soil Sampling***

Surface and subsurface soil samples (including sediment samples) were collected to determine the presence or absence of contamination in the soils. The following sections discuss details of the soil sampling activities and procedures used at VHFS.

##### ***2.2.6.1 Subsurface Soil Boring and Sampling***

Prior to the initiation of onsite drilling activities, available underground utility maps for each proposed drilling location were reviewed by SAIC. Based on this review, drilling locations were marked in the field by SAIC personnel and subsequently inspected and cleared by VHFS utilities personnel.

Deep boreholes (i.e., greater than 2 feet BLS) were drilled using 4¼-inch inside diameter (ID), continuous flight hollow-stem augers operated from a truck-mounted Mobile B-57 drilling rig. Soil samples were collected using a 2½-inch ID carbon steel split spoon sampler. Soil samples were collected for lithologic, chemical, and geotechnical analysis. The interior of each split spoon was lined with four stainless steel sleeves and four brass sample sleeves. Each sleeve was 3 inches in length and 2½ inches in diameter. Blow counts were recorded in the field logbook and used to estimate the relative density of the soil being sampled. Ten percent of the

samples collected during the SI were submitted for geotechnical analysis that included grain size (ASTM D-422), Atterberg limits (ASTM D-4318), and percent moisture. Air quality at each drilling location was continuously monitored for VOCs using a PID. No concentrations of VOCs were identified in the breathing zone at concentrations above the detection limit of the instrument.

The SAIC onsite geologist recorded the lithology and completed the drilling logs for each soil boring completed during the field investigation. Each log included a description of the soil collected in each split-spoon sampler and conditions encountered during drilling. The field boring logs are provided in Appendix D.

Soil samples from each borehole were field screened for VOCs using a PID. Soil from the drive head of the sampler was removed and the PID probe was inserted into the sampler (top and bottom) to obtain an initial VOC measurement. The reading was noted in the field logbook. The split spoon was subsequently opened after it had been screened and the first brass sleeve from the lead end of the spoon was prepared as the VOC sample. The top and bottom of each sample sleeve was sealed with a 4- by 4-inch Teflon® sheet and covered with plastic caps. The plastic caps were then secured to the sleeve with 1-inch Teflon® tape and then labeled and placed in a sealed plastic bag. Metals samples were collected from the stainless steel sleeve in the same manner described above. If analysis for additional parameters other than VOCs and metals were required, the remaining sample was homogenized in a stainless steel bowl and placed in labeled 8-ounce glass jars. All of the soil samples collected in the field were stored in coolers at  $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$  prior to shipment to the testing facility.

Following the collection of each soil sample, the borehole was abandoned using a grout mixture composed of 20 parts cement (Portland cement type II) to 1 part bentonite (by weight) with a maximum of 8 gallons of U.S. Army Environmental Center (USAEC)-approved water per 94-pound bag of cement. The grout was mixed by hand and then pumped into the open borehole through a rigid tremie pipe until undiluted grout flowed from the boring at ground surface. Each abandoned location was later examined and more grout was added if settling had

occurred. All drilling tools and the drilling rig were decontaminated between AREEs according to the protocols outlined in Section 2.2.11.

#### **2.2.6.2 Surface Soil Sampling**

Metals and VOC samples were collected at shallow soil depths (0 to 2 feet BLS) using a stainless steel core sampler (approximately 2 inches in diameter and 6 inches long) that was advanced with a hand-held slide hammer attachment. The core sampler was lined with brass and stainless steel sleeves, which were used to collect the samples for laboratory analysis. The stainless steel sleeve was loaded at the lead end of the sampler, with the brass sleeve above it. The metals sample was collected in the stainless steel sleeve and the VOC sample was collected in the brass sleeve. The core sampler was placed on the location to be sampled and the slide hammer extended and accelerated downward to advance the sampler into the ground. The sampler was retrieved after being driven approximately 6 inches into the ground, and the sleeves were immediately removed and sealed with 4- by 4-inch Teflon® sheets. Plastic caps were then placed over the Teflon® sheets at each end of the sleeve and secured with 1-inch Teflon® tape. The sleeves were then labeled and placed in sealed plastic bags. All of the soil samples collected in the field were stored in coolers at  $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$  prior to shipment to the testing facility.

Samples for the remaining analytical parameters were collected by removing a sufficient amount of soil from the same sampling location using a stainless steel trowel and homogenizing the sample in a stainless steel bowl. The soil was placed into 8-ounce amber glass jars and then labeled and placed in sealed plastic bags. All sampling equipment was subsequently decontaminated in accordance with the methods outlined in Section 2.2.11. Sampling information was recorded in the field logbook and on the field sampling forms (see Appendix E).

#### **2.2.6.3 Sediment Sampling**

Sediment samples were taken at the western South Run tributary near the Vehicle Maintenance Area (AREE 9) and from the drainage ditch at the Pistol Range (AREE 19). The sediment sample from the tributary was taken slightly downstream from the Vehicle Maintenance Area outfall in an area of still water that was approximately 1 foot deep. The sample was



collected using a stainless steel spoon to transfer sediment into the sample jars, which were then promptly capped. The jars then were labeled and placed into plastic zipper bags in coolers.

The sediment samples taken at the Pistol Range (AREE 19) were collected using decontaminated stainless steel trowels to dig sediment from the drainage ditch. The sediment was placed in a stainless steel bowl and composited before distribution into amber glass jars. The jars then were labeled and placed in plastic zipper bags in coolers. Sampling information from all sediment samples was recorded in the field logbook and on the field sampling forms (see Appendix E).

#### **2.2.6.4 Soil Hydraulic Push Sampling**

Soil samples were collected at screened AREEs using a small diameter percussion-driven steel probing tool with a retractable drive point. The probing tool was driven using a truck-mounted hydraulic percussion unit (Geoprobe) that pushed and hammered the probe to the desired sampling depth. Once the sampling depth was reached, the probe or drive point was retracted and the soil sample was collected.

Soil samples were collected using the hydraulic push sampling techniques at two borehole sample locations within Warehouse (AREE 3) (two sample locations at the former hydraulic lifts). The planned boring at the grease pit sump could not be sampled due to access problems within the Warehouse. Prior to soil sampling, a 2-inch auger drill was used to bore through the 2 feet of concrete overlying the former hydraulic lifts. The soil sample was then collected by pushing an open-ended sample rod into the soil at the depth just below the concrete layer (i.e., 2 feet BLS). As the sample rod was driven into the ground, soil was collected in three 8-inch stainless steel liners contained within the sample rod. The rod was then pulled out of the hole and visual characteristics of the sample were logged (i.e., color, grain size, and soil type) and the soil was screened for volatiles with a PID. For the first location, one 8-inch sleeve was used for each of the VOC, TPH, and metals analyses. However, because recovery was low at the second location, one 8-inch sleeve was used for VOC analyses and the other 8-inch sleeve was used for both TPH and metals analyses. The ends were covered with 4-inch Teflon® sheets and then sealed with plastic caps. After wrapping with 1-inch Teflon® tape, the sleeves were

labeled, placed in sealed plastic bags, and cooled to  $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$  prior to delivery to the laboratory.

#### **2.2.7 Groundwater Investigation**

The surficial groundwater at VHFS was investigated to determine the character and composition of the aquifer. The following sections describe the procedures used to install groundwater probes and monitoring wells and determine aquifer characteristics.

##### **2.2.7.1 Groundwater Hydraulic Push Sampling**

Groundwater probes were installed using hydraulic push techniques at Dump #1 (AREE 1) (1 location), Dump #2 (AREE 12) (5 locations), Dump #3 (AREE 17) (4 locations), Sand Filter Beds (AREE 21) (3 locations), Possible Sludge Disposal Area (AREE 29-2) (3 locations), and Disposal Area (AREE 29-4) (5 locations). However, because the probes could not be advanced to the water table in some locations because of the presence of consolidated material, only nine probes contained groundwater. Groundwater samples were collected at Dump #1 (1 location), Dump #2 (1 location), Sand Filter Beds (2 locations), Possible Sludge Disposal Area (2 locations), and Disposal Area (3 locations). Upgradient samples could not be collected at Dump #2, Dump #3, Sand Filter Beds, or the Possible Sludge Disposal Area due to the absence of groundwater in the probes.

At the designated sample locations, a sampling rod was attempted to be driven approximately 5 feet below the anticipated groundwater level. Driving the rod below the anticipated depth of the water table would help ensure that a water sample could be retrieved and allow for a greater volume of water to accumulate in the borehole. Unfortunately, the presence of consolidated material prevented most probes (11 of the planned 21 probes) from reaching the expected depth. When the probe reached the deepest level achievable, the steel casing was retracted and the borehole was allowed to fill with formation water.

After the steel casing was retrieved, a 5-foot section of narrow slotted polyvinyl chloride (PVC) pipe connected to one or more 5-foot sections of PVC riser pipe was inserted to the full depth of the hole. This slotted pipe served as a temporary location from which water level

measurements and groundwater samples were collected. A 21-inch long by ¼-inch ID stainless steel bailer was then lowered into the probe to collect the groundwater sample. The groundwater in the bailer was used to fill the sample bottles. (The sample bottles were single rinsed rather than triple rinsed due to the low yield of the wells.) The order of priority for sampling used in these low-yield wells was as follows: VOCs, metals, SVOCs, pesticides/PCBs, and TPH.

Following collection of water level measurements and samples for chemical analysis, the portion of the riser pipe extending above ground was capped. The water level measurements helped determine the general groundwater flow direction in the area of the investigated AREEs. All probes were subsequently abandoned by removing the well casing and filling the borehole with bentonite and American Society for Testing and Materials (ASTM) water.

#### **2.2.7.2 Monitoring Well Drilling and Installation**

A total of 15 monitoring wells were drilled and installed at VHFS during the supplemental SI field effort conducted from May through June 1995. Three wells were installed at each AREE (Dump #2 [AREE 12], Dump #3 [AREE 17], Sand Filter Beds [AREE 21], Possible Sludge Disposal Area [AREE 29-2], and Disposal Area [AREE 29-4]). Monitoring wells were installed to evaluate the hydrochemical and hydrogeologic characteristics of each AREE. In addition, soil samples were collected during monitoring well drilling activities for lithologic record and geotechnical testing. Rock coring activities were conducted to characterize the local geology. Well installation activities (i.e., soil sampling, drilling, and well construction) are discussed in greater detail in the following sections.

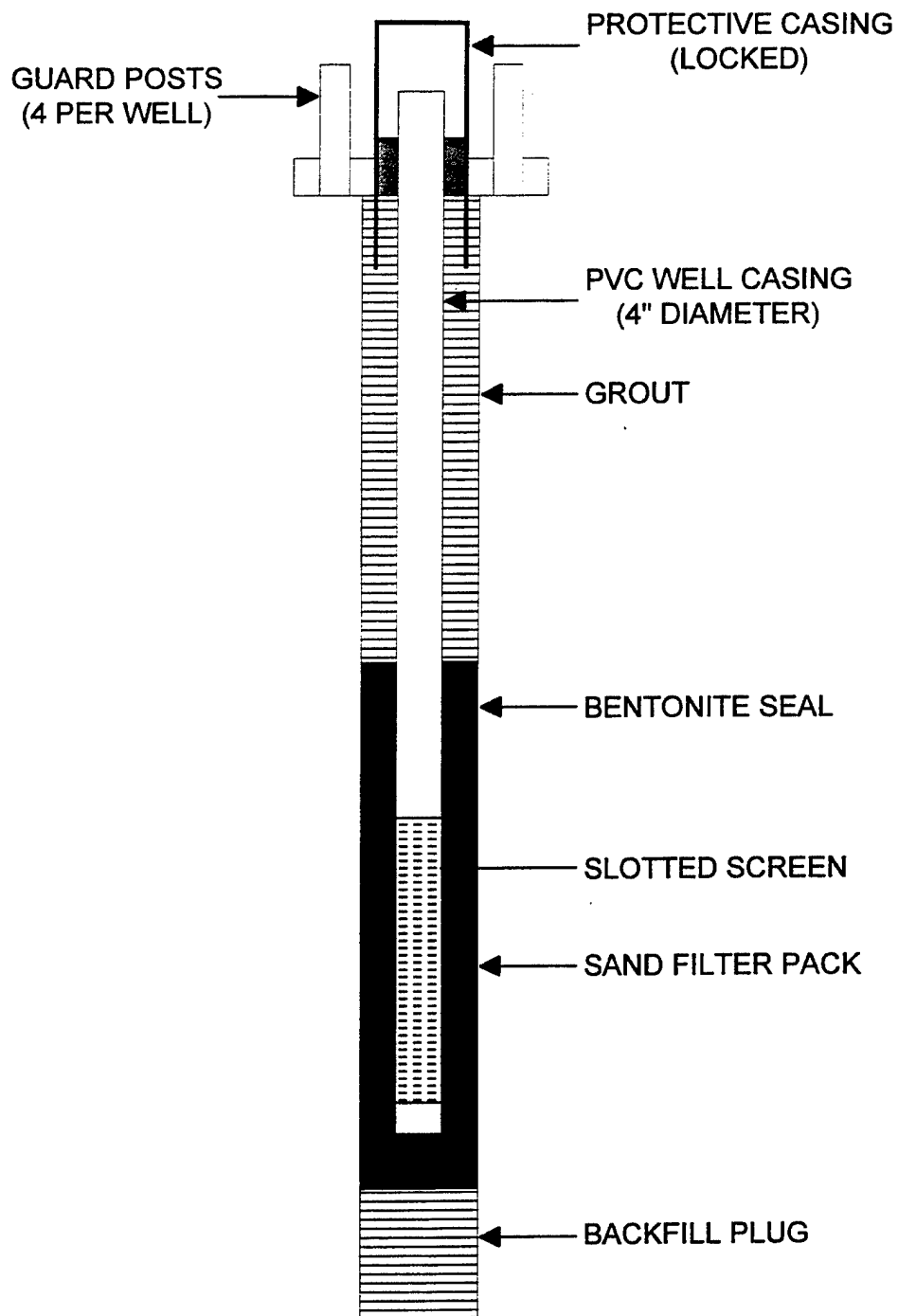
Soil samples were collected using a Canterra CT250 Torque Master drill rig with HSA, air rotary, mud rotary, and coring capabilities. Samples were collected using a carbon steel split spoon with a 2-inch ID and 2 feet in length. Split spoons were decontaminated in accordance with procedures outlined in Section 2.2.11 prior to collecting each sample. The drill rig's 140-pound manual hammer (with a 30-inch drop) was used to drive the split spoons into the ground. Blow counts were recorded and used to qualitatively determine relative density of the soil. Samples were collected at 5-foot intervals (maximum) until bedrock was encountered. An organic vapor monitor (OVM) was used to screen the split spoon after it had been removed from

the borehole. After screening the spoon, geotechnical and lithologic archive samples were collected and placed into two 8-ounce jars for permanent record. Soil descriptions were logged on a field boring form and are provided in Appendix D.

Rock coring activities were conducted at well locations MW-12-001, MW-17-001, MW-21-002, MW-PS-001, and MW-DA-003 to obtain a geologic record of subsurface consolidated material. A carbon steel core barrel with an impregnated diamond bit was used to collect a 1 7/8-inch core. Conventional and wire line coring activities were conducted using potable water from the USAEC-approved source to cool the bit and lift cuttings out of the borehole. Rock cores were removed from the core barrel and placed into wooden boxes for archiving purposes. Information written on core boxes included the soil boring/well identification, date, cored interval, run number, percent recovery, orientation of the core (i.e., the top and bottom of the run), revolutions per minute, and approximate down pressure. The core was described by the rig geologist and logged on a field boring form using the format presented in the *Geotechnical Requirements for Drilling, Monitor Wells, Data Acquisition, and Reports* (USATHAMA 1987).

After completing soil sampling and coring activities, the borehole was reamed to total depth (TD) using an 8-inch OD down hole hammer. An Ingersoll Rand air compressor capable of providing a pressure of 250 psi was used to power the hammer. Air flowed through a double filter system as required by USAEC. If the well location was not designated to be cored, the borehole was reamed to TD after soil sampling activities were completed and before bedrock was encountered.

Monitoring well installation activities were initiated after the borehole had been reamed to depth. Prior to insertion into the borehole, well casings and well screens were decontaminated by steam cleaning, scrubbing with an Alconox® solution, and rinsing with potable water. A typical well construction is diagrammed in Figure 2-2 and specific well construction details are shown in Table 2-3. The monitoring well construction logs in Appendix D show the specifications of the materials used on a well by well basis at VHFS. Any variations from the



### Typical Well Construction

Vint Hill Farms Station,  
Warrenton, Virginia  
SI Report

Figure:  
2-2

Project:  
01-0827-03-6521-062

Date:  
10/3/95

**Table 2-3. Summary of Well Construction Details  
Vint Hill Farms Station, Warrenton, Virginia**

Well Number <sup>a</sup>	Water Level <sup>b</sup> (feet below TOC)	Well Depth <sup>c</sup> (feet below TOC)	Screen Length (feet)	Top of Filter Pack (feet below TOC)	Development Time <sup>d</sup>
MW-12-001	26.08	40.45	10	23.9	90 gallons/9 days
MW-12-002	11.46	35.50	10	17.4	145 gallons/2 days
MW-12-003	10.18	52.11	10	35	230 gallons/2 days
MW-17-001	15.20	48.93	10	27.4	193 gallons/7 days
MW-17-002	8.02	32.85	10	15.4	186 gallons/2 days
MW-17-003	10.28	37.65	10	19.9	162 gallons/5 days
MW-21-001	8.98	27.62	10	8.5	490 gallons/2 days
MW-21-002	3.41	20.34	10	5.5	232 gallons/3 days
MW-21-003	3.39	32.68	10	15.0	224 gallons/4 days
MW-PS-001	8.90	32.42	10	15.0	286 gallons/4 days
MW-PS-002	2.32	23.48	10	7.6	164 gallons/4 days
MW-PS-003	3.22	22.96	10	6.9	111 gallons/3 days
MW-DA-001	3.21	37.98	15	14.5	180 gallons/7 days
MW-DA-002	2.74	32.65	10	14.9	152 gallons/7 days
MW-DA-003	4.15	22.85	10	6.8	290 gallons/12 days

<sup>a</sup> All wells are constructed of PVC and are 4 inches in diameter.

<sup>b</sup> Water level measurements are from the top of casing (TOC) and were measured in June 1995 prior to sampling.

<sup>c</sup> Well depth measurements are from the TOC and were measured in June 1995 prior to sampling.

<sup>d</sup> Five well volumes (i.e., the volume of water in the well casing and filter pack) were removed from each well during development in June 1995.

standard well construction were approved by USAEC prior to being implemented and are discussed in greater detail in Section 2.3.6.

#### **2.2.7.3 Well Development**

Well development activities were not initiated until at least 48 hours (but not later than 7 days) after the placement of the internal mortar collar, in accordance with USAEC protocols. The wells were developed using a variety of equipment, including bailers, hand pumps, submersible pumps (Grundfos®), and pneumatic pumps, depending on well productivity. Wells were developed by removing a minimum of five times the volume of standing water in the well including the saturated annulus. Additional water volumes equivalent to five times the volume of water losses to the borehole were removed as part of the well development. An exception to this standard would be for wells that did not recharge to almost static level within 4 hours. Wells MW-17-001 and MW-12-001 were very slow producers and did not recharge within 4 hours. Therefore, the required five well volumes (including water lost during drilling activities) were not removed. However, SAIC personnel worked on these wells continuously to remove as much water as possible during the allotted schedule.

Specific conductivity, pH, and temperature measurements were obtained periodically during the well development process. Stabilization of these parameters in conjunction with purge volumes were utilized as criteria for determining development completion. Groundwater clarity was qualitatively observed and documented during development. A sample of groundwater from the developed well was archived onsite. Development water was containerized and stored onsite pending analytical testing. Well development forms, contained in Appendix D, provide additional information regarding each well.

#### **2.2.7.4 Geotechnical Testing**

Ten of the samples collected during well drilling activities were sent to a geotechnical laboratory for grain size (ASTM D422-63) and Atterberg limits (ASTM D4318-84). The Unified Soil Classification System (ASTM D-2487) was used to identify the soil types. The results of these tests are discussed in Section 3.1 and provided in Appendix H.

#### 2.2.7.5 Slug Testing

Aquifer slug tests were conducted on one groundwater monitoring well at each of the five AREEs (Dump #2 [AREE 12], Dump #3 [AREE 17], Sand Filter Beds [AREE 21], Possible Sludge Disposal Area [AREE 29-2], and Disposal Area [AREE 29-4]) recommended for supplemental hydrogeologic investigations. The tests were conducted to determine the hydraulic conductivity of the screened aquifer. Slug tests are conducted to measure the rate of recovery of the water level inside a well after a known volume of water is added or removed. Rising head permeability slug tests were performed at VHFS. This type of slug test entails removing a volume of groundwater and recording the return of the water level to a static position.

Prior to initiating each slug test, the initial water level and total depth of the monitoring well were measured to the nearest 0.01 feet and recorded in the field logbook. The Hermit® data logger (model SE 1000) was calibrated according to manufacturer's instructions for slug tests with a logarithmic time scale in minutes and hours, and draw-down in feet. A pressure transducer (10 psi) was lowered to between 0.5 and 1 foot from the bottom of the well. A decontaminated submersible pump with tubing was lowered into the well and positioned approximately 1 foot above the transducer. The transducer was sufficiently submersed under water (a minimum of 15 feet above the transducer) prior to the start of every slug test. The water in the well was allowed to stabilize prior to initiating the slug test. The Hermit® data logger was set to the ready mode (per manual instructions) with a reference value of zero. Prior to initiating the well purging, field personnel recorded the initial water level, stabilized water level, data logger test number, and corresponding well number in a field logbook.

The well was purged until the water level was at the same depth as the pump intake. Purge water was containerized in 55-gallon drums. The pump was permitted to run 1 to 2 minutes after the water had been pumped down to the proper depth to ensure water contained in the sand pack had been allowed to drain out. Simultaneously, the pump was turned off and the Hermit® data logger was turned on to begin collecting recharge data. The depth to water was determined using the Hermit® data logger while the test was running, with the exception of well MW-PS-001. Well MW-PS-001's water level was hand-tagged with a water level indicator (WLI) probe while the test was running, and it is believed that this action affected



the data. The Hermit® data logger automatically recorded the time and draw-down values. After reaching 90 percent recharge, the Hermit® program was terminated. The equipment was removed and the wells were secured.

Data obtained during each slug test was stored on computer disk and the data were analyzed using curve matching techniques in the Aqtesolv™ (Geraghty & Miller 1991) software package. An initial curve match was obtained using automatic, non-linear curve matching and the curves were manually adjusted. The data were analyzed using the Cooper et al. (1967) analytical method. Assumptions associated with the application of this analytical solution include:

- Aquifer has infinite areal extent
- Aquifer is homogeneous, isotropic, and of uniform thickness
- Aquifer potentiometric surface is initially horizontal
- Aquifer is confined
- Well storage is negligible
- Water slug is removed/added instantaneously
- Flow to well is horizontal.

The results are discussed in Section 3.1.2 and shown in Appendix D.

#### **2.2.8 Water Sampling**

Groundwater and surface water samples were collected at several AREEs to determine if contamination exists at the AREE or downgradient from the AREE. The following sections describe the procedures used to collect groundwater and surface water samples at VHFS.

##### **2.2.8.1 Water Level Measurements**

The water level and well depth were measured in each groundwater monitoring well prior to initiating well purging activities and after sampling was completed. An electric water level indicator (Hunter/Keck KIR-89) was used to measure the water level from the top of the well casing. The water level was then recorded to the nearest 0.01 foot on a water level

measurement form (Appendix F). The water level measurements were used to determine groundwater flow directions and calculate the volume of water that was required to be purged from each well prior to obtaining groundwater samples for chemical analysis.

#### 2.2.8.2 Well Purging

Prior to the collection of groundwater samples for chemical analysis, each well was purged using either a 1½-inch disposable Teflon® bailer, a 3-inch reusable Teflon® bailer, or a 2-inch Grundfos® submersible pump. Because most of the purge volumes were very low (i.e., less than 60 gallons), a 1½-inch Teflon® bailer was used on most of the wells.

A well volume was considered to be the standing column of water in the screened interval and riser pipe, as well as the calculated volume of water in the sand pack. Measured depths to groundwater were used to calculate the height of standing water in the well, and therefore, the volume of standing water in each well and the purge volume. The calculations to determine purge volume inside the well were obtained using the following equation:

$$V_1 = \pi(r)^2 \times h \times 7.48$$

where

$V_1$  = Volume of water in well (gal)

$r$  = Well radius (ft)

$h$  = Height of standing water column (ft).

The volume of water in the sand pack to be purged was calculated using the equation:

$$V_2 = \pi(R-r)^2 \times h \times \rho \times 7.48$$

where

$V_2$  = Volume of water in the sand pack (gal)

$R$  = Radius of the sand pack (ft)

- $r$  = Radius of the well casing (ft)  
 $h$  = Height of water in the sand pack (ft)  
 $\rho$  = Porosity of the sand pack (0.30).

The two volumes ( $V_1$  and  $V_2$ ) were summed to calculate the purge volume of a single well volume. If the well went dry before five well volumes were purged and had a slow recovery rate (i.e., the water column did not rise greater than 90 percent after 1 hour), the well was designated a "slow recharger." The well was then purged to dryness a second time (except for GW05W, which was only purged to dryness once) and sampled when a sufficient volume of groundwater was present in the well. This method was approved by the USAEC geologist for "slow rechargers" after discussions with the SAIC Field Manager and SAIC QA Officer. As shown in Table 2-4, most of the wells purged were "slow rechargers."

Parameters, including temperature, pH, and specific conductivity, were monitored during purging and recorded in the field logbook and field sampling form (Appendix E). Well purge water was containerized at each well and then transported to a central storage location pending the results of chemical analysis of the groundwater.

#### **2.2.8.3 Groundwater Sampling**

Groundwater samples were collected from the well as soon after purging as there was a sufficient volume of water in the well for the intended chemical analyses. Groundwater was retrieved using a point-source, bottom-filling disposable 1½-inch diameter Teflon® bailer and used to rinse each sample bottle three times, except for VOC sample vials. At four wells (GW05W, GW06W, MW-21-001, and MW-17-001), the sample bottles were single rinsed rather than triple rinsed due to low volumes of groundwater in the well. After the bottles had been rinsed properly, a groundwater sample was collected with the bailer and dispensed directly into the sample bottles. The bottles were labeled and placed in plastic zipper bags in coolers. Samples were collected immediately before and immediately after sampling to measure temperature, pH, clarity, and specific conductivity. Water level measurements also were collected before and after sampling. Sampling information was recorded in the field logbook

**Table 2-4. Monitoring Well Purging Information  
Vint Hill Farms Station, Warrenton, Virginia**

Well	Water Level* (ft to TOC)	Total Depth* (ft to TOC)	Well Volume** (gallons)	Purge Amount (gallons)	Comments
GW01W	18.85	37.90	20.79	22	Purged to dryness twice; slow recharger
GW02W	14.10	36.87	22.33	65.5	Purged to dryness twice; slow recharger
GW03W	16.41	37.09	20.82	59	Purged to dryness four times; slow recharger
GW04W	4.80	16.88	13.46	72	Removed 5 well volumes
GW05W	8.16	16.18	9.16	8.0	Purged to dryness once; very slow recharger
GW06W	10.70	23.28	14.37	13.1	Purged to dryness twice; very slow recharger
GW07W	5.64	22.29	16.72	26	Purged to dryness twice; slow recharger
GW08W	3.02	17.85	14.31	21	Purged to dryness twice; slow recharger
GW09W	12.70	102***	87.77	175	Purged to dryness twice; slow recharger
GW14W	3.95	14.70	10.93	55	Removed 5 well volumes
MW-12-001	26.86	40.33	16.74	20	Purged to dryness twice; very slow recharger
MW-12-002	12.24	35.4	25.88	136	Removed 5 well volumes at ~1 gpm
MW-12-003	11.01	52.4	37.92	63	Purged to dryness twice; slow recharger
MW-17-001	15.09	48.0	33.72	60	Purged to dryness twice; slow recharger
MW-17-002	11.14	33.1	24.94	135	Removed 5 well volumes at ~1 gpm

TOC - Top of Casing

\*Water level and total depth measurements for wells GW01W through GW14W were taken on November 9, 1994. Water level measurements for the remaining wells were taken on June 7, 1995.

\*\*The well volume is the sum of the water in the well and in the sand pack.

\*\*\*The 100-foot measuring tape could not reach bottom. Actual well installation depth is used.

**Table 2-4. Monitoring Well Purging Information  
Vint Hill Farms Station, Warrenton, Virginia (continued)**

Well	Water Level* (ft to TOC)	Total Depth* (ft to TOC)	Well Volume** (gallons)	Purge Amount (gallons)	Comments
MW-17-003	12.35	37.5	27.00	60	Purged to dryness twice; slow recharger
MW-21-001	9.85	27.6	22.05	135	Removed 5 well volumes at ~2.5 gpm
MW-21-002	3.94	20.3	19.48	120	Purged to dryness twice; slow recharger
MW-21-003	4.52	32.6	29.03	70	Purged to dryness twice; slow recharger
MW-PS-001	9.06	32.4	25.65	42	Purged to dryness twice; slow recharger
MW-PS-002	2.69	23.5	23.05	40	Purged to dryness twice; slow recharger
MW-PS-003	4.01	23.3	22.32	38	Purged to dryness twice; slow recharger
MW-DA-001	3.53	37.7	36.20	75	Purged to dryness twice; slow recharger
MW-DA-002	2.79	32.6	30.26	42	Purged to dryness twice; slow recharger
MW-DA-003	4.18	22.8	21.72	49	Purged to dryness twice; slow recharger

TOC - Top of Casing

\*Water level and total depth measurements for wells GW01W through GW14W were taken on November 9, 1994. Water level measurements for the remaining wells were taken on June 7, 1995.

\*\*The well volume is the sum of the water in the well and in the sand pack.

\*\*\*The 100-foot measuring tape could not reach bottom. Actual well installation depth is used.

and on the field sampling forms (Appendix E). None of the groundwater samples was filtered prior to collection.

#### **2.2.8.4 Surface Water Sampling**

Surface water samples were collected from the South Run tributary near Dump #1 (AREE 1) and the western South Run tributary near the Vehicle Maintenance Area (AREE 9). Surface water samples were collected by holding the rim of a decontaminated 5-gallon Nalgene® bucket beneath the surface of the water. To prevent the introduction of sediments into the surface water sample, care was taken to not disturb the stream bottom. The surface water sample taken near the Vehicle Maintenance Area was collected prior to collecting the sediment sample in an effort to further minimize introduction of sediments. The water in the bucket was then used to fill the sample bottles. Each sample bottle was rinsed three times with surface water before samples were collected, except for VOC sample vials. For samples requiring chemical preservation, the preservative was added after the sample bottle was filled. Bottles were labeled and placed in plastic zipper bags in coolers. Field measurements for temperature, pH, and specific conductance were taken from the water source. Sampling information was recorded in the field logbook and on the field sampling forms (Appendix E).

#### **2.2.9 Wipe Samples**

Wipe samples were collected from the walls of Building 253 (a storage shed within the engineering compound) and Building 320 (a maintenance building in the housing area) to help determine if residual pesticides or herbicides were present due to past storage of these materials. Wipe samples were taken by firmly wiping a piece of sampling gauze, moistened with a small amount of pesticide-grade hexane, over the area sampled. A 10- by 10-centimeter (cm) section of the wall in each building was thoroughly sampled. In Building 253, the pesticide wipe sample was taken from one of the masonry walls in the pesticide storage room. The herbicide wipe sample was taken from one of the masonry walls in the herbicide storage room. In Building 320, the samples were taken from the north wall. After sample collection was completed, the gauze was placed in a 100-mL amber glass bottle, labeled, placed in a cooler, and then sent to the laboratory for analysis.

### ***2.2.10 Topographic Surveying***

A topographic survey was conducted to determine the map coordinates of particular activities included in the field investigation. The topographic survey established coordinates for the 9 groundwater probes at Dump #1 (AREE 1) (1 probe), Dump #2 (AREE 12) (1 probe), Sand Filter Beds (AREE 21) (2 probes), Possible Sludge Area (AREE 29-2) (2 probes), and Disposal Area (AREE 29-4) (3 probes); the corners of the SOV survey grids at Dump #1, the Former Service Station Abandoned USTs (AREE 28-5), and Sugar Tree (AREE 25); the transect lines of the geophysical survey grids at the Former Service Station Abandoned USTs, Salvage Yard (AREE 29-1), and Possible Disposal Area (AREE 29-3); the 5 manhole covers (not covered by a building or a parking lot) and end of the pipe for the EPIC industrial sewerline; and the 15 groundwater monitoring wells installed as part of the supplemental SI. All topographic survey efforts were conducted by a certified surveyor (J.F. Veatch) with a current surveyor's license in the State of Virginia (Land Surveyor License #1986). The surveying information and summary tables are provided in Appendix G.

The topographic surveying information was input to the existing Autocad™ drawing of VHFS to provide accurate placement of the groundwater probes, geophysical and SOV grids, and manhole covers. However, according to VHFS graphics personnel, the Autocad™ drawing of VHFS used scanned data from aerial photographs rather than from surveyed information. As a result, the size and shape of the property is altered slightly on the Autocad™ drawing. For example, the surface area of the property is calculated on the electronic drawing at 690 acres, when it is actually 701.1 acres, a slight (1.6 percent), yet important, difference. When the topographic information was input to the Autocad™ drawing, the probes, grids, and manhole covers were placed in obviously incorrect locations (relative to the other buildings and roads). Each probe, grid, and manhole cover had to be relocated based on the existing spatial relationships.

Global Positioning System (GPS) surveying was used to establish Virginia State Plane Coordinates at VHFS. Basing the survey control on the National Geodetic Survey (NGS) control monument at VHFS (PID: HV9700), the Virginia State Plane Coordinates established for this site were stated as NAD 1927. The NAD 1927 coordinates were established by NGS through

the High Accuracy Reference Network (HARN). The control monument at VHFS is part of the HARN control loop for the Commonwealth of Virginia.

The GPS control loop run through the site had excellent closures, with all control loops closing better than 1:100,000 (less than 10 ppm). Subcontrol loops run through the site had closures better than 1:86,000. All horizontal distances were reduced to sea level based on a scale factor of 0.999951 and all horizontal and vertical coordinate values were based on a conversion to the U.S. Survey foot (1 meter = 3.2808333 feet).

The vertical control was based on two NGS monuments and the HARN monument at VHFS. Elevations obtained for this site are based on NGS monument T-142 1935 (HV3679). Elevations were derived by differential spirit leveling with an end closer of 0.03 feet.

#### ***2.2.11 Decontamination***

Drilling equipment (i.e., rig, tools, augers, and bits) was decontaminated by steam washing the equipment with a laboratory-grade, nonphosphorus detergent (i.e., Alconox®) solution and rinsing materials with water from the approved potable source (i.e., VHFS Water Supply Well #3). Drilling equipment was decontaminated between drilling locations at a temporary decontamination pad constructed on the south side of the Auto Craft Shop (AREE 4) area. Decontaminated equipment was wrapped in plastic for transport to the AREE to prevent contamination of the equipment and materials.

Sampling equipment (e.g., stainless steel trowels, split spoons, and ring liners) coming into direct contact with the sample media was decontaminated using the following procedures:

- Scrub equipment with a solution of laboratory-grade detergent (i.e., Alconox® or Liquinox®) using a brush
- Rinse equipment with water from a USAEC-approved source (i.e., VHFS Water Supply Well #3)
- Rinse equipment with ASTM water
- Rinse equipment with isopropanol and air dry
- Rinse equipment with ASTM water again, air dry, and wrap in aluminum foil.



Decontamination rinsate from soil sampling activities and from the drill rig was collected and containerized (see Section 2.2.12.2).

Rinsate blanks were collected from soil sampling equipment for each day of sampling. Rinsate blanks for groundwater sampling equipment (i.e., disposable Teflon® bailers) were collected from the first and last bailers out of each batch. The results of the rinsate blanks show that no significant residual contaminants remained on the surface of the equipment after decontamination.

### ***2.2.12 Investigation-Derived Waste Handling***

This section discusses the procedures that were used for containerizing investigation-derived waste (IDW) during the SI field effort at VHFS. The containerization of drill cuttings, purge water, decontamination wastes, and other solid wastes that were generated during SI field activities is discussed below.

#### **2.2.12.1 Drill Cuttings**

Fourteen drums of soil IDW were generated as cuttings during soil boring activities at VHFS. An additional 35 drums of soil IDW were generated as cuttings during monitoring well installation activities. Soil cuttings were containerized in 55-gallon drums, labeled, and transported to the Auto Craft Shop (AREE 4). Soil samples were collected from the drums, composited by AREE, and analyzed for toxicity characteristics leaching procedure (TCLP) VOCs, SVOCs, pesticides, herbicides, and metals. TCLP results indicated that all soil IDW was nonhazardous. The drums subsequently were disposed of at the Fauquier County landfill, in accordance with Virginia Department of Environmental Quality (VDEQ) guidance.

#### **2.2.12.2 Liquid Waste**

Seventeen drums of liquid IDW were generated from pre-sample purging activities of VHFS monitoring wells during the initial SI field activities. In addition, 11 drums of liquid IDW were generated from decontamination conducted during the initial SI field activities.

Liquid IDW from the initial SI field activities was containerized in 55-gallon drums, labeled, and transported to the Auto Craft Shop (AREE 4).

Development water, purge water, and decontamination water were generated during the monitoring well installation activities. These liquid wastes were containerized within six polyethylene tanks (three 1,050-gallon, two 500-gallon, and one 1,500-gallon) and twenty-one 55-gallon drums. The labeled tanks and drums were stored at the Auto Craft Shop (AREE 4).

Development and purge water were disposed of at the VHFS STP (AREE 2) after a review of groundwater sample results by the installation. Decontamination water was disposed of at the VHFS STP after review of TCLP sample results by the installation. TCLP results indicated that all decontamination water was nonhazardous.

#### **2.2.12.3 Miscellaneous Solid Waste**

Eleven drums of miscellaneous solid IDW (e.g., Tyvek® coveralls, nitrile gloves, and plastic sheeting) were generated during the VHFS SI field effort. Solid IDW was containerized in 55-gallon drums, labeled, dated, and relocated to the Auto Craft Shop (AREE 4). The IDW subsequently was disposed of in a sanitary landfill after review of the soil and groundwater sample analytical results.

#### **2.2.13 Field Equipment**

Instruments and equipment used to gather, generate, or measure environmental data were calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results were consistent with the manufacturer's specifications. All field equipment was calibrated and operated in accordance with the field standard operating procedures (SOPs) provided in the Final SI Sampling and Analysis Plan (SAP) (SAIC 1994c).

The satisfactory operating condition of equipment and instrumentation used onsite was verified before each piece of equipment was shipped to VHFS. All equipment and instrumentation was calibrated daily before field activities began and immediately recalibrated

if field personnel suspected that calibration may have been altered. All calibrations were recorded in the Calibration Log (Field Logbook #3).

#### **2.2.13.1 Health and Safety Monitoring Instrumentation**

Calibration of health and safety instruments was performed daily, before use, at the intervals specified by the manufacturer, or more frequently if field personnel suspected that calibration may have been altered. Health and safety instruments included two Thermo Environmental Instruments Model 580B organic vapor monitors. These PIDs used a 10.0 electron volt (eV) lamp and had a response time of 1 second. Calibration was performed using 100 ppm isobutylene gas.

#### **2.2.13.2 Water Quality Measurements**

All instruments used to conduct water quality measurements were calibrated before use and more frequently if field personnel suspected that calibration may have been affected by an external factor (e.g., temperature or humidity). Water quality measurement instrumentation included a Hydac™ pH/conductivity/temperature meter, a Hunter/Keck™ water level indicator, and a Weksler™ mercury thermometer.

#### **2.2.14 Health and Safety Activities**

All activities were conducted in accordance with the approved SI Health and Safety Plan (HASP) (SAIC 1994c). All workers wore modified Level D protection (i.e., Tyvek® coveralls, steel-toe boots, latex gloves, and a hard hat). Upgrade to Level C protection was not required at any time during the SI field program. No injuries were reported during activities and no incident reports were filed. A list of emergency numbers and a hospital route map were posted inside all vehicles.

All SAIC subcontractors working onsite at VHFS received a comprehensive health and safety review prior to initiating work and each morning during the field program prior to starting work. The briefing was provided by the onsite Health and Safety Officer and the SAIC Field

Manager. The onsite Health and Safety Officer ensured that all training records and the signed worker acknowledgement forms were in his files prior to allowing work to proceed.

#### *2.2.15 Quality Assurance/Quality Control Activities*

The objectives of the QA/QC program for the VHFS SI were two-fold. The first objective was to control and characterize any errors associated with the collected data. The second QA/QC objective was to illustrate that the SI at VHFS had been conducted according to specifications in the VHFS SI SAP (SAIC 1994e) and Quality Assurance Project Plan (QAPP) (SAIC 1994d), *USATHAMA Quality Assurance Program, PAM 11-41* (January 1990), and *Geotechnical Requirements for Drilling, Monitor Wells, Data Acquisition, and Reports* (USATHAMA 1987). Both of these objectives were met.

SOPs were used to locate and collect samples so that known and acceptable levels of precision, accuracy, representativeness, comparability, and completeness (PARCC) were achieved. All environmental samples and associated field QC samples were analyzed and validated using methods commensurate with the *USATHAMA Quality Assurance Program, PAM 11-41* (January 1990) to achieve these PARCC parameters for the sample data. All PARCC data quality objectives (DQOs) were met. Section 3.2 provides a more detailed analysis of the data validation results.

QC activities, such as the collection of field duplicates, equipment rinsates, trip blanks, and source water samples, were utilized to characterize any errors in data due to improper sample handling or equipment decontamination. These samples were collected at the rates specified in the VHFS SI QAPP and their results are discussed in Section 3.2 of this report. A field audit was conducted to ensure that the procedures specified in the SAIC SOPs and VHFS SI Work Plan and QAPP were followed. No violations or deviations from these procedures were noted by the SAIC QA Officer during the field audit.

## 2.3 MODIFICATIONS FROM PLANNED ACTIVITIES

Although activities conducted under the SI were extensively planned and agreed to by SAIC, USAEC, VDEQ, and EPA Region III personnel, site conditions encountered during the investigation necessitated modifications from the original planned effort (see Table 2-1). The following sections discuss the modifications of procedures, methods, and any other criteria in the approved Final SI SAP (SAIC 1994e). These modifications, which are discussed below, were instituted in the field due to unforeseeable circumstances and did not adversely affect the SI DQOs.

### 2.3.1 *Soil Organic Vapor Survey*

The SOV survey was anticipated to be performed at 50-foot intervals over a 300- by 300-foot grid at Dump #1 (AREE 1). However, due to the encroachment of the woods to the east, a smaller grid was used. The samples, which would have been taken in the wooded area, were instead used to track a potential plume of contamination in the middle of Dump #1. According to historical aerial photographs and visual evidence, the wooded area is undisturbed and has not been used for disposal. Thus, the DQOs were achieved for this site over a smaller area.

### 2.3.2 *Soil Push Borings*

There were three push borings planned for the interior of the Warehouse (AREE 3). However, one of the push borings could not be obtained due to access problems within the warehouse. The garage doors leading to the former grease pit had been blocked and the truck-mounted hydraulic probe could not maneuver within the tight spaces of the interior.

### 2.3.3 *Groundwater Probe Samples*

Twenty-one groundwater probes were installed as an alternative to monitoring wells at Dump #1 (AREE 1), Dump #2 (AREE 12), Dump #3 (AREE 17), the Sand Filter Beds (AREE 21), the Possible Sludge Disposal Area (AREE 29-2), and the Disposal Area (AREE 29-4). However, 11 of the 21 installed probes could not be sampled due to the absence of groundwater. The hydraulic pushing equipment could not advance the 1-inch probes deep

enough into the consolidated material to reach below the water table. In cases where the water table was reached, the tight soils of the overburden allowed only a minimal recharge into the wells and prevented the collection of a sufficient volume of sample for some chemical analyses. For those locations where insufficient water volume was obtained from the push probes, monitoring wells were installed during the supplemental hydrogeological investigation.

#### ***2.3.4 Subsurface Drilling and Sampling***

One soil boring was planned for each of the neutralization pits at the Vehicle Maintenance Area (AREE 9). However, the neutralization pit next to Building 290 was not sampled because it was found to have a concrete bottom. One soil boring planned for the northeast section of the Former Photographic Wastewater Lagoon (AREE 10) could not be drilled due to access problems on the muddy terrain. In addition, the second soil sample planned for collection at one of the background boring locations could not be collected due to the unexpected shallowness of the bedrock. The background borings were planned to be drilled to a depth of approximately 20 feet BLS. However, one soil boring was drilled to a total depth of only 7 feet BLS because bedrock was encountered.

#### ***2.3.5 Test Pits***

Two soil samples were planned for the Salvage Yard (AREE 29-1). However, because evidence of contamination was not found in the test pits (only inert debris was discovered during the test pit excavation), these soil samples were not collected.

#### ***2.3.6 Monitoring Wells***

Monitoring wells were constructed in accordance with USAEC geotechnical requirements (USATHAMA 1987), but due to variations encountered in the field, it was necessary to deviate from the required specifications. The thickness of the bentonite seals and sand filter packs for wells MW-DA-003, MW-PS-002, MW-PS-003, and MW-21-002 were reduced because a shallow water table was encountered. The reductions in seal and sand pack thickness permitted the unencumbered installations of a 5-foot protective well casing into fresh grout.

In some instances, the production limitations of the aquifer required the length of screen or the amount of sand filter pack above the screen to be increased. The screened interval for well MW-DA-001 was set between 20 and 35 feet BLS to ensure the water-producing zones of the borehole were fully screened. The sand filter pack for well MW-17-001 was placed 8 feet above the top of the screen for the same reason. Both of these wells recharged to less than 50 percent within 1 hour and are considered to be very slow rechargers.

All deviations from the planned scope of work were approved by USAEC representatives prior to implementation. The actual measurements of each well are shown on monitoring well construction logs in Appendix D.

### **3. RESULTS OF FIELD INVESTIGATION**

This section details the results of the Site Inspection (SI) and supplemental activities conducted at Vint Hill Farms Station (VHFS) and provides an assessment of each area requiring environmental evaluation (AREE) regarding the presence or absence of environmental contamination and recommended additional activities. Data used to assess each site are provided below, and detailed analytical data for the AREEs are presented in the appendices.

Section 3.1 describes the geology and hydrogeology at VHFS to provide information on the environmental conditions encountered. An assessment of the data quality is provided in Section 3.2 to determine the validity of sample results. Section 3.3 describes the protection standards that were used to determine if compounds and analytes are present at significant concentrations. The results of the background sampling are provided in Section 3.4 with an explanation of how sample results from the AREEs were compared to background data. Section 3.5 describes the methods and results of the streamlined risk assessment. The AREE-specific results are presented in Section 3.6.

#### **3.1 SITE GEOLOGY AND HYDROGEOLOGY**

This section presents an overview of the general geologic and hydrogeologic characteristics of the VHFS area and site-specific evaluations based on the results obtained during the SI and supplemental field activities.

##### **3.1.1 Geology**

VHFS is situated in the Culpeper basin, which was formed during the Jurassic and/or Triassic period. This basin is located near the border of the Coastal Plain and Piedmont physiographic provinces and is one of a series of tensional faulted, graben-like trenches that extend from Nova Scotia to Georgia along the Appalachian mountain system. The series of trench systems or Triassic basins was formed by downfaulting as a result of fracturing associated with the Triassic-Jurassic continental split of North America. During the Mesozoic Era, igneous rock intrusions occurred along joints, faults, and other zones of weakness in the Paleozoic-age sedimentary rock found at VHFS. The faulting that accompanied this period of igneous intrusion

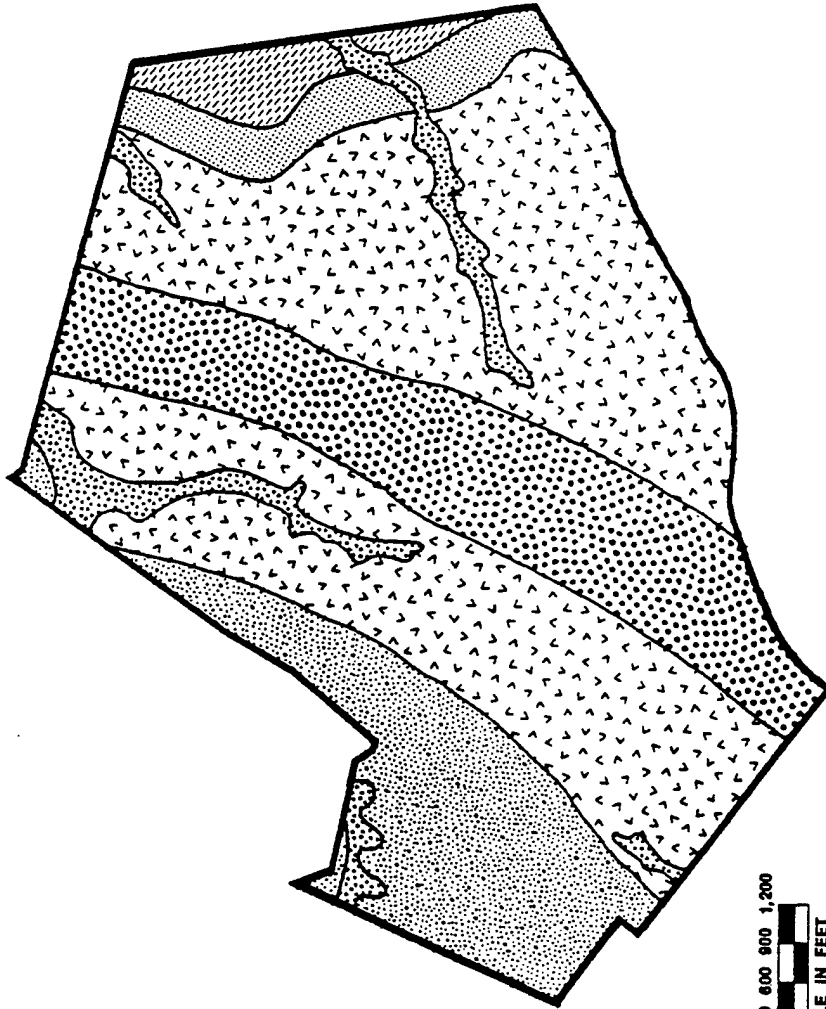
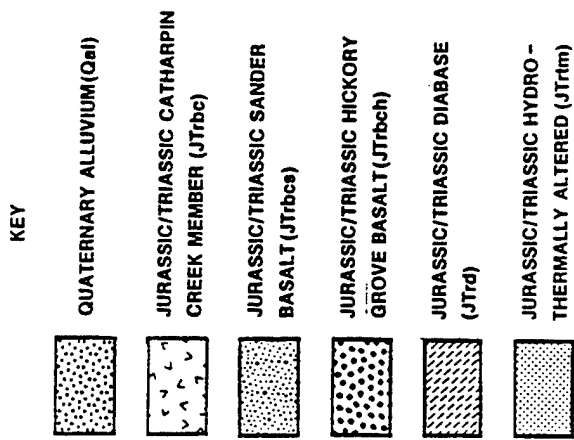


resulted in a complex structural system of overthrust fault blocks, intrusive dikes and sills, and irregular areas of contact metamorphism. At VHFS, this system manifests itself as three mafic intrusions that bisect the sedimentary bedrock (ESE 1986).

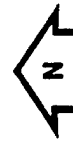
The sedimentary rocks of the VHFS area consist of beds of sandstone, arkosic sandstone, siltstone, shale, and claystone. Igneous rocks identified in this area consist of basalt, which is in contact with metamorphic rocks consisting predominantly of hornfels. Basalt comprises the predominant near-surface rock in the western portion of the installation; sedimentary "red beds" (sandstone, siltstone, shale, and claystone) are common on the eastern portion of VHFS. During the Environmental Contamination Survey (ESE 1986), bedrock was encountered at depths ranging from 4 feet below land surface (BLS) on the northern portion of the installation to a depth of 39 feet BLS on the southern portion of the installation. Figure 3-1 shows the surficial geology of the VHFS area. The sedimentary beds and basalts form an irregular surface that is covered by varying thicknesses of saprolite, rock fragments, sand, silt, and clay. Figure 3-2 shows the thickness of the unconsolidated material throughout VHFS as identified during the Environmental Contamination Survey (ESE 1986).

During the SI field activities conducted in 1994 and 1995, 32 borings and 15 monitoring wells were drilled at 15 AREEs and 3 background locations throughout VHFS. The subsurface conditions encountered during these drilling activities were consistent with findings of the Environmental Contamination Survey (ESE 1986). Bedrock was identified at depths ranging from approximately 5 feet BLS at boring SB-18-002 located in the north central portion to approximately 23 feet BLS at boring SB-BK-003 located in the south central portion of the installation. The overburden identified was predominantly saprolite and was composed of silt, silty-clay, and clayey-silt with lesser amounts of clay and little angular gravel. The color of the material ranged from yellow brown (10YR 4/4) to dark reddish brown (5YR 3/3). Logs of all of the soil borings drilled during the SI are contained in Appendix D.

Rock coring activities conducted during the supplemental field effort provided data consistent with previous findings. The underlying geology at all of the sites is predominantly siltstone and shale, and/or sandstone, with the exception of well MW-17-001. These strata are



0 300 600 900 1,200  
SCALE IN FEET



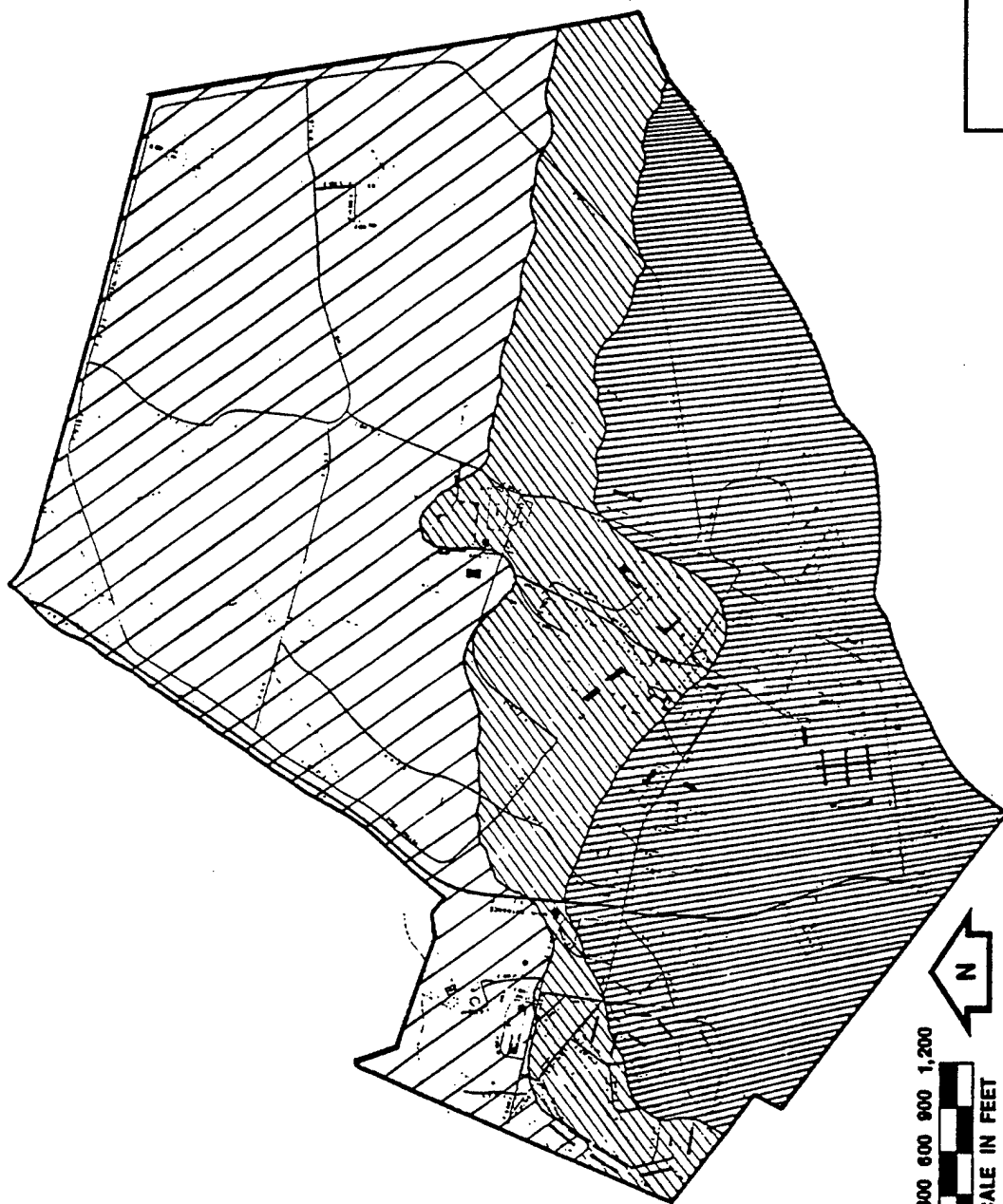
SOURCE: Lee, 1979 and 1980.



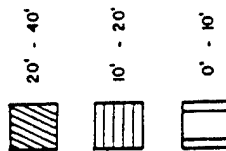
Surficial Geology of VHFS

Vint Hill Farms Station, Warrenton, Virginia

Figure: 3-1 | Project: 01-0827-03-6521-010



SOIL/SAPROLITE THICKNESS



Thickness of Unconsolidated  
Residual Material on VHFS

Vint Hill Farms Station, Warrenton, Virginia

Figure: 3-2 | Project: 01-0827-03-6521-010

SOURCE: U.S. Army Corps of Engineers, Baltimore District, n.d.

believed to be part of the Carpathian Creek Member that is found in the eastern and central western portions of VHFS. At well MW-17-001, basalt was encountered and is believed to be part of the Bull Run Formation. The core from well MW-17-001 showed this rock to be very competent with a low primary permeability and very few open fractures. The depth to bedrock varied from approximately 4 feet at the Possible Sludge Disposal Area (MW-PS-002) to approximately 12 feet at Dump #2 (MW-12-001). The overlying material consisted mostly of silts and clays. Soil boring logs from all of the wells are provided in Appendix D.

Geotechnical properties (Unified Soil Classification System [USCS] classification, grain size, and Atterberg limits) of soils on VHFS have been previously investigated during both phases of the SI. The majority of the analyses indicate that the overlying material consists predominantly of silt and clay. The plastic limit, plastic index, and liquid limit of VHFS soils varied from 0 to 57 percent, 0 to 35.4 percent, and 0 to 28 percent, respectively. The geotechnical test results from both phases of the investigation are provided in Appendix H.

### ***3.1.2 Hydrogeology***

Current information suggests that the groundwater system in the area of VHFS is a single aquifer system composed of weathered bedrock (saprolite) overlying less weathered bedrock. The upper portion of the aquifer is considered to range in depth from land surface in the marshy areas adjacent to the intermittent streams to approximately 60 feet BLS. This portion of the aquifer is located in the unconsolidated overburden material and the weathered, decomposed bedrock. Groundwater is identified in the bedrock portion of the aquifer at depths ranging from 36 to 180 feet BLS. This portion of the aquifer consists of fractured bedrock that is not as extensively weathered as the shallow portion of the aquifer. The fractured bedrock is composed of arkosic sandstone, siltstone, basalt, and diabase. The shallow portion of the aquifer at VHFS has been the focus of the environmental investigations conducted at the installation. Lithologic data collected during the Environmental Contamination Survey (ESE 1986) indicated that the groundwater encountered in the VHFS area occurs under water table conditions; no confining layers were identified in the upper portion of the aquifer or at the overburden/bedrock interface.

The bedrock portion of the aquifer system is used as the drinking water source for approximately 400 residents and a working population of 2,000 at VHFS (Weston 1990). Currently, three production wells at VHFS provide potable water for the VHFS residents and personnel. Seven public wells and 250 private wells are located within a 4-mile radius of VHFS and provide water to more than 2,700 residents.

As part of the SI field activities conducted in November 1994, 21 groundwater push probes were installed at locations throughout VHFS to collect groundwater samples for chemical analysis and to provide a location to collect groundwater elevation measurements. The shallow, near surface bedrock limited the ability to drive all of the push probes to depths that would intercept groundwater; groundwater was encountered at only nine locations. Water level elevations were measured from the 9 push probe locations and 14 existing wells and used to plot the groundwater flow for VHFS. All of these monitoring points were located generally in the northern portion of VHFS and were installed in the upper portion of the aquifer. The push probe locations were abandoned in December 1994 using a bentonite slurry.

During the supplemental SI field effort, water level measurements were collected in June and July 1995 from the 14 existing and 15 newly installed wells. The groundwater elevation data from June were used to plot the groundwater flow direction for VHFS, as shown in Figure 3-3. The information presented on the map indicates that groundwater in the western and central portions of the installation generally flows to the north-northwest; groundwater in the eastern portion of the installation flows to the east. The Environmental Contamination Survey (ESE 1986) indicated a groundwater divide located in the northeastern portion of the installation near monitoring well GW13W; this groundwater divide also appears on the current figures.

The water level elevation data for each site were used to determine the groundwater flow direction on a localized level. The groundwater flows in a northwesterly direction through Dump #2 (AREE 12), Dump #3 (AREE 17), and the Possible Sludge Disposal Area (AREE 29-2). Groundwater at the Sand Filter Bed (AREE 21) moves toward an intermittent tributary north of the site in an easterly to northeasterly direction. The groundwater flow for the Disposal Area (AREE 29-4) moves in a northeasterly direction. Previous data indicated the



groundwater at the Disposal Area was flowing in an easterly direction and site monitoring wells (MW-DA-001, -002, and -003) were placed at suspected upgradient and downgradient locations based on that data (ESE 1986). However, the current groundwater flow direction shows these wells to be cross-gradient of the site. Variability in the groundwater flow direction is likely to occur in localized areas at VHFS dependent on local topography, proximity to surface water bodies, and subsurface geology and structure. Water level measurement forms and site-specific groundwater plots are provided in Appendix F.

Field hydraulic conductivity values were estimated by conducting slug tests at five wells on the SI AREEs. The hydraulic conductivity values ranged between  $8.02 \times 10^{-6}$  and  $5.86 \times 10^{-4}$  cm/sec. Table 3-1 summarizes the estimated values for each well and data plots for each test are provided in Appendix D.

**Table 3-1. Calculated Slug Test Hydraulic Conductivity**

Well	Hydraulic Conductivity (cm/sec)	Aquifer
MW-12-002	$1.04 \times 10^{-4}$	Shale/Siltstone
MW-17-002	$9.54 \times 10^{-5}$	Shale/Siltstone
MW-21-001	$5.86 \times 10^{-4}$	Shale/Siltstone
MW-DA-003	$8.02 \times 10^{-6}$	Weathered Shale/Siltstone
MW-PS-001	$6.61 \times 10^{-5}$	Shale/Siltstone/Sandstone

Using average measured and estimated aquifer parameters for the Main Post ( $K = 1.72 \times 10^{-4}$  cm/sec;  $i = 0.02$  ft/ft;  $n = 10\%$ ), groundwater flow velocity across the area of VHFS is calculated to be 0.098 ft/day. The installed monitoring wells generally produced much less than 1 gallon per minute (gpm) with well MW-21-001 producing at a rate up to 2.5 gpm during well development and sampling.

Parameters obtained during groundwater sampling activities consisted of temperature, pH, and conductivity measurements. Groundwater temperature ranged from 51.9° to 71°F with an average of 61°F. The pH for groundwater ranged from 6.00 to 12.28 standard units (s.u.) with

an average of 7.34 s.u. Groundwater conductivity varied from 72.2 to 1,489  $\mu\text{mhos/cm}$  with an average conductivity of 440  $\mu\text{mhos/cm}$ .

### 3.2 DATA QUALITY ASSESSMENT

A comprehensive quality assurance/quality control (QA/QC) program was followed during the SI conducted for the U.S. Army Environmental Center (USAEC) at VHFS to ensure that analytical results and the decisions based on these results are representative of the environmental condition at the 27 AREEs.

The following documents were consulted during the evaluation of the QC data: the *U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) Quality Assurance Program, PAM 11-41* (January 1990); QC requirements contained within the guidelines and specifications presented in the Quality Assurance Project Plan (QAPP) submitted as part of the project plans prepared by Science Applications International Corporation (SAIC) (SAIC 1994d); the *Installation Restoration Data Management Information System (IRDMIS), Volume II Data Dictionary*, Potomac Research Institute (PRI) (1995); the U.S. Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) *Statement of Work for Inorganics Analysis*; the EPA CLP *Statement of Work for Organics Analysis*; and the EPA document *Laboratory Data Validation Functional Guidelines for Evaluating Organics and Inorganics Analysis* (EPA 1988). The number of soil, sediment, surface water, and groundwater samples collected during the VHFS SI, in addition to the number of field QC samples collected and selected laboratory QC (i.e., matrix spikes and duplicates) samples analyzed, are summarized in Appendix I. The data validation worksheets are referenced within the subsection describing the applicable analysis. The QC checks and results are summarized below.

#### 3.2.1 Data Quality Objectives

A comparison of the VHFS SI analytical results to project data quality objectives (DQOs) as defined in the QAPP (SAIC 1994d) formed the basis for evaluating the quality of the analytical data. As described in the QAPP, analytical data must be of a known and acceptable quality in order to be used to evaluate contamination at VHFS. DQOs are qualitative and quantitative indicators of data quality. DQOs were established during the initial scoping process



to guide the implementation of the field sampling and laboratory analyses for the VHFS SI. A QA program was established to standardize procedures and document activities. The program provided a means to detect and correct any deficiencies in the process. The VHFS SI was intended to determine the presence or absence of contamination and the chemical nature of detected contamination. DQOs are set to define and establish the criteria against the fitness of the data. Both quantitative and qualitative DQOs were established for the VHFS SI. Data verification and validation of 30 percent of the resulting analytical data packages ensured that DataChem Laboratories (DCL) produced an acceptable quality level for results. Control of field activities affecting precision and accuracy were produced by strict adherence to approved standard operating procedures (SOPs) and documentation of the field tasks. Field logbooks noted exceptions to the procedures and chain-of-custody records tracked sample shipments and receipt by DCL. These results confirmed that no cross-contamination due to sample handling practices or inadequate equipment decontamination occurred. Sampling precision was estimated by the analysis of field duplicate samples. Indicators used to assess both field and laboratory data quality include precision, accuracy, representativeness, comparability, and completeness (PARCC). The following sections summarize the DQOs for the PARCC parameters obtained during the VHFS SI.

#### **3.2.1.1 Precision**

Precision is a measure of the degree of the repetitiveness of a determination of an analytical result. It can be defined as the agreement between the numerical values of two or more measurements that have been under identical conditions. Precision can thus be seen as a measure of the magnitude of the errors. The overall precision of the measurement data is a mixture of sampling and analytical factors. Analytical precision can be measured through the analysis of USAEC Class 1 and 1A spiked QC sample recoveries, and sampling precision and spatial variability of contamination can be assessed through the analysis of the field duplicates. Precision is stated in terms of standard deviation, coefficient of variation, range, and relative percent difference (RPD). The RPD between results of duplicate samples for a given compound or element traditionally has been used to assess precision between two samples. The RPD is defined as the ratio of the absolute value of the difference between two results and the mean of the results. RPD was calculated using the equation provided in Appendix I.

When the RPD approaches zero, complete agreement is achieved between duplicate sample pairs, indicating a high degree of precision. Precision was evaluated based on the analysis of three different types of QC samples: USAEC Class 1, 1A, and 1B spiked QC samples, matrix spike/matrix spike duplicates (MS/MSDs), and replicate field sample analyses.

The first type of QC sample, USAEC spiked QC samples, is required as part of the USAEC analytical program for all methods. USAEC spiked QC samples provide ongoing information on the performance of each analytical method in a standard matrix. The results are compiled on single-day and 3-day control charts (i.e., X-bar and range) and submitted to the USAEC Geology and Chemistry Branch for approval before sample results may be loaded into the IRDMIS data base. The QC charts (i.e., single-day and 3-day range control charts) show that all analyses performed by gas chromatography/mass spectrometry (GC/MS), gas chromatography (GC), ion chromatography (IC), inductively coupled argon plasma (ICAP), graphite furnace atomic absorption (GFAA), cold vapor, and colorimetric techniques have acceptable precision with a few exceptions. These exceptions are attributable to the fluctuations in analytical sensitivity and are considered to have a minimal impact on data usability. Appendix I summarizes these exceptions.

The second type of QC sample used to assess the precision of the data quality was the RPDs of the MS/MSD samples. The laboratory selected 1 sample in 20 and split the sample into 3 sample portions. MS/MSD samples were prepared by routinely analyzing the first portion for the parameters of interest, while the remaining two portions were spiked with known quantities of the parameters of interest before analysis. The RPD between the spike results was calculated and used as an indication of the analytical precision for the organic (volatile organic compounds [VOCs], semivolatile organic compounds [SVOCs], organochlorine pesticides, herbicides, polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans [dioxins/furans], and total petroleum hydrocarbons [TPH] compounds), metals, cyanide, and miscellaneous water quality analyses (i.e., common anions, nitrate-nitrite, and total phosphate). The RPD between the two concentrations was calculated and used as an indication of the analytical precision for the analyses performed. However, the usefulness of the RPD is limited to samples that contain contaminants above the certified reporting limit (CRL) or method detection limit (MDL) so that

the random background and signal fluctuations are a small percentage of the signal, and therefore, do not contribute significantly to the measured precision. In addition, samples in a solid matrix with a high degree of inhomogeneity can exhibit lack of precision in the duplicate analysis.

Four RPD values (10 total values) calculated from the VOC soil MS/MSD analyses were within the EPA CLP advisory control limits. Two RPD values (of 22 total values) calculated from the SVOC soil MS/MSD analyses were outside the EPA CLP advisory control limits for analytical precision. Since each analysis was evaluated according to the required QC criteria described in Appendix I (Section I.3), and all of these criteria were met for the environmental samples analyzed, these RPD values are considered to be a more representative reflection of the variability characteristic of the environmental condition at VHFS. As a result, the analytical DQO for VOC and SVOC precision is considered to have been met.

USAEC water analyses for organochloride pesticides/PCBs are representative of the organic compounds in that RPDs were either below 20 percent or near 120 percent values. This is attributable to a number of MS/MSD results reported greater than (GT) the upper limit due to evaporation of sample during storage. The VHFS QAPP (SAIC 1994d) specifies criteria for the laboratory precision based on the RPD in MS/MSDs for metals. The acceptable upper limit applied to each analytical lot for inorganic water and soil analyses is 30 percent. One RPD value (of 47 values reviewed) for metals MS/MSD soil analyses did not meet 30 percent criteria. This result is considered to have little impact on the environmental data quality and considered more likely to be the result of the regional matrix variability, since all other required analytical QC criteria were met. Therefore, the analytical precision DQO for metals analyses is considered to have been met.

One TPH RPD value (of 2 values reviewed) for soil MS/MSDs was outside the appropriate control limit; however, this result is considered to have no adverse impact on the overall environmental data quality. All RPD values calculated from VOC, SVOC, vinyl chloride, polynuclear aromatic hydrocarbons (PAHs), herbicides, dioxins/furans, hexachlorocyclopentadiene (CL6CP), TPH, and metals water MS/MSD analyses were within the

EPA CLP advisory control limits or method control limits. One RPD value for pentachlorophenol (PCP) MS/MSD water analyses did not meet the advisory control limit of 50 percent. This result is considered to have little impact on the environmental data quality and considered more likely to be the result of the regional matrix variability or field activities, since all other required analytical criteria were met. All RPD values (total three values) calculated from herbicide soil MS/MSD analyses were within the method control limits. All common anion, nitrate/nitrite, and total phosphate RPD values were within the applicable control limit; therefore, the analytical precision DQO for those analyses is considered to have been met. The analytical QC criteria used to evaluate analytical precision and all MS/MSD results are discussed in Appendix I (Section I.3).

The third type of QC sample, field duplicate samples, were included as part of the SI. Field duplicate samples assess the precision of the sampling techniques and spatial variability of the contamination. Field duplicate samples were collected using the same techniques as those used to collect the environmental samples. Field duplicates were collected during the VHFS SI at a rate of 1 duplicate per 10 field samples. No specific control limits for field precision were established in part because the natural heterogeneity of the environmental media was much greater than the variability imparted by field activities.

Field RPD values were calculated only for compounds and elements detected in concentrations greater than the CRLs in both duplicate pair samples or in one sample. Appendix I (Table I-2) provides a summary, by medium and analyte, of the RPD and absolute difference for field replicates.

Soil heterogeneity imparts a large degree of uncertainty to what might be considered representative values. Average RPDs were calculated only for that analyte or compound detected in at least two field duplicate pairs. Average RPDs in soil range from roughly 9 to 151 percent for metals, 39 to 142.9 percent for SVOCs, and 47.3 percent for TPH. Average RPD values for water demonstrate small differences between field duplicates. In fact, the soil field duplicates were more variable than groundwater field duplicates as deduced from average values. Overall, project precision for environmental analyses has been determined to be

adequate for the uses of the analytical data, which were to identify the contaminants and provide an assessment of the distribution of each analyte (i.e., the spread of the reported values about their mean) in both soil and water matrices. A comprehensive discussion of all field duplicate sample results is presented in Appendix I (Section I.2.3).

### 3.2.1.2 Accuracy

Accuracy is the closeness of agreement between an observed result and the true value for a sample analysis. Accuracy can be evaluated for a particular method by measuring the agreement between an observed result from analysis of a reference standard analyzed with an analytical lot and its certified value. Accuracy is usually expressed in terms of bias (high or low). Bias is assessed by the percent recovery of a compound or element that has been added to the QC sample or environmental sample prior to the analysis. Sampling accuracy is assessed by evaluating the results of the source water, trip blanks, and equipment rinsates; analytical accuracy is assessed through the use of USAEC spike QC samples and MS/MSDs. Analytical accuracy is expressed as the percent recovery of a compound or element that has been added to the environmental sample at a known concentration before analysis. The percent recovery values were calculated using the equation presented in Appendix I.

Analytical accuracy for this project is measured through the use of Class 1, 1A, and 1B USAEC spiked QC samples (low and high spike recoveries), surrogate spiked QC samples (only GC/MS), surrogate field samples (GC, high-performance liquid chromatography [HPLC], and high resolution GC [HRGC]/low resolution MS [LRMS]), and MS/MSD samples. Each type of spiked sample provided different information on the accuracy of the measurement system.

Class 1, 1A, and 1B USAEC spike QC sample recoveries were used as a primary control of accuracy in the laboratory system. The laboratory plotted the mean percent recovery and range of percent recovery on control charts for each control chemical. The laboratory utilized the percent recovery of each chemical in USAEC spiked QC samples, the average percent recovery, and the difference between the percent recovery of two high spiked samples in a continuous assessment of method accuracy.

The USAEC QC control charts show that all analyses performed by GC/MS, GC, ICAP, GFAA, cold vapor, and colorimetric techniques had acceptable accuracy, except for lots AQDM, AQGE, AQEI, AQGK, AQHJ, AQFK, AQGI, AQKU, ATAD, ASZM, and ATGO. These out-of-control situations are expected to have minimal impact on data usability.

A variety of individual recoveries (i.e., USAEC Methods UH10, KK8, AX8, JD21, JD20, Y9, JS12, SS12, UM25, LM25, LM23, UM21, and TT09) were slightly outside the control limit. The magnitude of these points was attributed to normal variation in the distribution of recovery values for the method. The impact of these individual points on data quality is believed to be negligible.

The second type of QC used to assess the accuracy of the data quality was the percent recoveries of the surrogates spiked into standard method blanks for VOC and SVOC analyses. Surrogate compounds spiked into standard matrix method blanks provide information on the accuracy and precision of the analysis of each analytical lot and indicate out-of-control situations. VOC lot AQBT had 3-day X-bar control charts that were out-of-control. They were slightly below the lower control limits (LCLs). However, no environmental samples showed detectable VOC concentrations; therefore, the impact of these out-of-control situations is negligible.

Four QC blanks in lots AQFV and AQHO for MEC6D8 and ETBD10 were out-of-control. Because of the low spike recoveries, the detected VOC concentrations may be quantitated slightly low. SVOC lot AQFS had 3-day control charts for 2-fluorophenol (2FP) and 2,4,6-tribromophenol (246TBP) that were below the LCLs. The internal standards, instrument tune, and daily calibrations are acceptable, and as a result, the impact of these out-of-control situations is negligible.

A variety of individual recoveries for surrogates spiked into the VOC and SVOC standard matrix method blank were slightly outside the upper control limit (UCL) and LCL. However, they are not deemed to affect the field data because all internal standards, instrument tunes, and calibrations are acceptable. The magnitude of these points was attributed to normal variation in the distribution of recovery values for the method.

The third type of QC used to assess the accuracy of the data quality was the percent recoveries of the surrogates spiked into environmental samples for VOC, SVOC, vinyl chloride, PAH, and PCP analyses. Surrogate compounds spiked into field samples provide information on the efficiency of all steps of GC/MS, GC, HPLC, and HRGC/LRMS methods in recovering these compounds from the individual sample matrices. In the USAEC analytical program, surrogate recoveries spiked into environmental samples are not used to determine if an analytical method is in control. They are used to obtain information on recovery effects in the environmental matrix. The QC limits for recovery of all surrogates for soil and groundwater environmental samples for VOC and SVOC analyses were those established for the USAEC surrogate spiked QC sample and were submitted by DCL for each analytical lot (i.e., LCL and UCL). One hundred and sixty-three (of 274 reviewed values) and 269 (of 510 reviewed values) percent recoveries were outside the applicable control limits. Above average recoveries of the surrogates spiked into environmental samples indicate positive matrix interferences and the result may overestimate the true value. Below average recoveries indicate negative matrix interferences and the result may underestimate the true value. Most of the surrogate recoveries were low, possibly because these compounds were added at levels that were negligible to the amount of the total organic contamination. Based upon the pervasive low surrogate spike recoveries for VOCs and SVOCs, results may be biased low and may include false negatives. Three (of 62 reviewed values) PAH surrogate recoveries were above the higher limit. All supporting VOC, SVOC, and PAH information cited above also was qualitatively evaluated with respect to the analytical accuracy DQO. All of the surrogate recoveries spiked into the environmental samples analyzed for PAHs, PCP, vinyl chloride, and dioxin/furan compounds were within the method control limits.

While USAEC QC spike samples measure the accuracy of the methods independent of the sample matrix (i.e., the laboratory control sample [LCS] matrix is not the same as the environmental sample), accuracy determined by MS/MSD samples is a function of both matrix and method. Three VOC MS/MSD percent recoveries were outside the EPA CLP control limits for 30 percent of the data. Recovery values of 6 out of 66 reviewed SVOC MS/MSD results were zero. Below lower limit recoveries in the natural matrix spikes indicate negative matrix interferences and possible low bias data. Despite these values, no systematic laboratory error

was detected and the results are considered to have little impact on the overall environmental data quality.

Two PAH MS/MSD values exhibited higher recoveries due to possible matrix interferences. Ten organochlorine pesticide/PCB MS/MSD values (16 reviewed values) were above the UCLs and recovery values of 2 out of 12 reviewed values for herbicides MS/MSD analyses were above the method UCL. Above UCL recoveries in the natural matrix spikes indicate possible interferences and possible high bias data. Two chromium recovery values were lower than the 125 percent control limit. Antimony, lead, and selenium were consistently outside the 75-125 percent limits. Antimony, arsenic, lead, and selenium are typically difficult to recover and are subject to interferences. Antimony also exhibited poor MS/MSD recoveries because of losses incurred by volatilization during acid digestion. The MS/MSD recoveries exceeded the control limits six times for antimony and lead, eight times for selenium, and two times for arsenic. One cyanide recovery value was below the 75 percent limit. All supporting metals QC information cited above also was qualitatively evaluated with respect to the analytical accuracy DQO. Two recoveries (of 12 reviewed values) calculated from the TPH, TPH as gasoline, and TPH as diesel MS/MSD analyses were outside the 75-125 percent limits. PCP, vinyl chloride, CL6CP, dioxins/furans and common anions (i.e., bromide, fluoride, chloride, and sulfate), total phosphate, and nitrate-nitrite MS/MSD analyses had spike recoveries within the appropriate control limits. Based on the evaluation of the MS/MSD results and the associated laboratory QC results summarized in Appendix I (Section I.3), on a project-wide basis, the laboratory accuracy has been determined to be acceptable for all analyses, and as such, the analytical DQO for accuracy was met, except where noted.

Method blanks were analyzed with each analytical lot of environmental samples. Each method blank was evaluated for contaminants that prevent accurate quantitation of a target compound. The flag code (i.e., "B") was applied to two benzo(a)pyrene and to one dibenzo(a,h)anthracene concentration detected in MW-17-002 (SAIC01), MW-17-002 (SAIC02), and MW-17-001 (SAIC01), respectively, to indicate that benzo(a)pyrene and dibenzo(a,h)anthracene concentrations were five times less than the detected in the associated method blank and should be considered false positives. A flag code (i.e., "B") was applied to



all elements detected in USAEC QC spiked soil samples (i.e., QC-45577-1, QC-45577-2, QC-45577-3, QC-46212-1, and QC-46212-3) in concentrations less than five times that detected in an associated soil method blank. Despite the flag codes, these method blank results are not considered to have adversely impacted the groundwater sample data quality. Based on an evaluation of the compounds and elements detected in the method blanks, the overall field accuracy is acceptable, except where noted. As a result, the analytical DQO for accuracy is considered to have been met. A comprehensive discussion of analytical QC results is presented in Appendix I (Section I.3).

In addition, an analysis accuracy was calculated for all USAEC methods based on found versus recovered compounds. Analysis accuracy is reported with each applicable lot of the data to USAEC. Concentrations reported on IRDMIS reflect the accuracy of the analytical method.

Sampling accuracy was maximized by the adherence to the strict QA program presented in the VHFS QAPP (SAIC 1994d). All procedures (i.e., soil boring, soil, sediment, surface water, and groundwater sample collection procedures; equipment decontamination; and health monitoring equipment calibration and operation) used during the VHFS SI were documented in the Work Plan, QAPP, and field SOPs. Field QC blanks (i.e., source water, trip blanks, and equipment rinsates) were prepared to ensure that all samples represent the particular site from which they were collected, assess any cross-contamination that may have occurred, and qualify the associated analytical data accordingly.

During the VHFS SI sampling program, approximately 16 percent of the samples collected were field QC blanks (i.e., trip blanks and equipment rinsates) obtained to determine the degree of cross-contamination or ensure successful decontamination procedures. The majority of the trip blank results were generally below the CRLs. Acetone, 1,2-dichloroethane, and methylene chloride were detected at concentrations greater than the CRLs. An IRDMIS flagging code (i.e., "A") was applied to three acetone concentrations detected in PG-12-001, PG-PS-002, and SS-16-001 and to one vinyl chloride concentration in SW-09-001, to indicate that the acetone and vinyl chloride concentration was 10 times and 5 times, respectively, less than that detected in the associated trip blank. Therefore, all low level acetone and vinyl

chloride detects in these field samples are highly suspect and should be considered potential false positives. The flag code (i.e., "G") was applied to two endosulfan sulfate, two 4,4'-DDE, and two 4,4'-DDT values detected in GW09W (SAIC01) and GW09W (SAIC02) and to one 4,4'-DDT value and one 4,4'-DDE value detected in GW01W (SAIC01) and GW04W (SAIC01), respectively. The flag code (i.e., "G") also was applied to three benzo(k)fluoranthene concentrations detected in MW-12-003, MW-12-002, and MW-PS-001 and two total phosphate detects in GW05W (SAIC01) and GW05W (SAIC02). The flagged analytical results indicate that these concentrations are considered high bias because the concentrations detected in the environmental samples did not exceed five times the concentrations detected in the associated equipment rinsate. Despite the flag codes, these field QC results are not considered to have adversely impacted the groundwater sample data quality. Based on an evaluation of the compounds and elements detected in the field QC blanks, the overall field accuracy is acceptable, except where noted. As a result, the field DQO for accuracy is considered to have been met. A comprehensive discussion of the field QC results is presented in Appendix I (Section I.2).

#### **3.2.1.3 Representativeness**

Representativeness was defined as the degree to which the data accurately and precisely represent a characteristic of a population, parameter variations at a sampling location, a process condition, or an environmental condition. Representativeness is the qualitative parameter concerned most with the proper design of the sampling program. The soil sampling approach was a variation of the search sampling typically used in locating a suspected "hot spot." Soil data obtained from this sampling approach have the following limitations: concentration may not represent the average soil contamination and the distribution of contaminant concentrations may not accurately represent the distribution over the entire base. The sampling approach used in collecting groundwater samples was a purposive/judgmental sampling. Purposive/judgmental sampling is a potentially biased approach in which each sampling is based on a predetermined conceptual model or understanding of contamination.

Factors that affect the representativeness of the analytical data include improper preservation, holding times, use of standard analytical methods, and matrix or analyte

interferences. Holding times and preservation criteria are based on the most restrictive holding times recommended by USAEC for water and soil matrices. Sample representativeness was ensured during the VHFS SI by collecting sufficient samples of a population medium, properly distributed with respect to location and time. Representativeness was assessed by reviewing the drilling techniques and equipment, sample collection methods, equipment, and sample containers used during the VHFS SI, in addition to evaluating the RPD values calculated from the duplicate samples. The reproducibility of a representative set of samples reflects the degree of heterogeneity of the sampled medium, as well as the effectiveness of the sample collection techniques. Intervals for soil sampling were chosen to obtain the strata with the highest concentrations of contaminants in order to achieve the most conservative representation and to optimize the number of samples required.

Based on the evaluation of the factors described above and summarized in Appendix I (Section I.3), the samples collected during the VHFS SI are considered to be representative of the environmental condition at VHFS.

#### **3.2.1.4 Comparability**

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another and is limited to the other PARCC parameters, because only when precision and accuracy are known can one data set be compared to another. Quantitative criteria for determining if representativeness has been achieved are not specifically stated. To optimize comparability, only the specific methods and protocols that were specified in VHFS SI QAPP (SAIC 1994d), as required by the *USATHAMA Quality Assurance Program, PAM 11-41* (January 1990), were used to collect and analyze samples during the SI. By using consistent sampling and analysis procedures, all data sets were comparable within the AREEs at VHFS, among AREEs at the installation, and among U.S. Army facilities nationwide, to ensure that remedial action decisions and priorities were based on a consistent data base. Comparability also was ensured by the analysis of USAEC and EPA reference materials, establishing that the analytical procedures used were generating valid data. The VHFS SI utilized one laboratory to perform the USAEC analyses and the same sampling method for each medium. All samples collected for VOC, SVOC, pesticide/PCB, herbicide, hexachlorobenzene/

hexachlorocyclopentadiene, metals, common anion, total phosphate, and nitrate-nitrite analyses were analyzed using USAEC Class 1, 1A, and 1B methods. Samples collected for vinyl chloride, PAH, PCP, dioxin/furan, cadmium, thallium, antimony, and TPH analyses were analyzed using EPA solid waste methods and general chemical methods. Based on the precision and accuracy assessment presented above, the data collected during the VHFS SI are considered to be comparable with the data collected during previous investigations.

#### **3.2.1.5 Completeness**

Completeness was defined as the percentage of valid data obtained from the sampling and analysis process. For data to be considered valid, they must have met all acceptance criteria, including accuracy and precision, as well as any other criteria specified by the analytical methods used.

Furthermore, project completeness was defined as the percentage of data used to evaluate the magnitude and extent of contamination, and upon which recommendations for site remediation are based. For analytical data to be considered usable for further action recommendations, each data point must be satisfactorily validated. Results that have been flagged may be considered to have encountered minor problems with limited impact on the data quality. DQOs for the VHFS SI were set at 95 percent for the field sampling and laboratory completeness. Based on the evaluation of the field and laboratory QC results presented in Appendix I (Sections I.2 and I.3), 100 percent of the total environmental sample data collected during the VHFS SI was used as the basis for all recommendations presented in this report.

#### **3.2.2 Assessment Summary**

The VHFS SI field activities spanned 10 months. During that time, nearly 130 samples were collected, resulting in an analytical data base of more than 1,000 analyses. One hundred percent of the sample results from the VHFS SI field effort were used to complete the data quality assessment. From DCL and Quanterra Laboratory (i.e., dioxins/furans analyses), the mass of results from organics and inorganics were usable and fulfilled the needs of the SI. Overall, the quality of the analytical data is acceptable. The one limitation affecting data interpretation and usage is that low level acetone, endosulfan sulfate, 4,4'-DDE, 4,4'-DDT,

isodrin, benzo(a)pyrene, dibenzo(a,h)anthracene, benzo(k)fluoranthene, and total phosphate detects in specific samples are highly suspect and should be considered potential false positives.

The significant efforts that went into the data review and validation process resulted in acceptable data quality for use in the SI.

### **3.3 PROTECTION STANDARDS**

This section describes the basis for the comparison of AREE sample data to protection standards based on applicable, relevant, and appropriate requirements (ARARs) or to-be-considered (TBC) guidance. Sample results from each AREE were compared to the protection standards to provide information that will support recommendations for further investigations or no further action.

#### ***3.3.1 Soil Protection Standards***

There are no enforceable standards for contaminants in soil resulting from waste disposal activities. Instead, risk-based concentrations (RBCs) for soil are used for the comparison. The RBCs are target concentration limits based on human health risk estimates or health-based ARARs.

The RBCs used in the comparison are protective of a receptor during both childhood and adulthood (chronic, long-term exposure) who is exposed to contaminants in soil via the ingestion route. The RBCs assume residential land use with the exception of the Sewage Treatment Plant (AREE 2) where industrial land use RBCs were used. Soil RBCs were applied to both surface and subsurface soils at VHFS. The RBCs are published by EPA Region III and the most recent concentrations (from June 1996) are presented in their entirety in Appendix K. All RBCs relevant to this investigation are contained in the data tables in Section 3.6.

As noted by EPA Region III, the RBCs may be used as no-action levels or cleanup goals, with the provision of several caveats:

- A single medium is contaminated
- Volatilization or leaching is minimal
- The land use assumed in the RBCs is appropriate for the AREE
- The target risk levels assumed in the RBCs are appropriate for the AREE
- There is minimal potential for ecological risk.

The RBCs are calculated using a target hazard index (HI) of one and a target cancer risk of  $1 \times 10^{-6}$ . The target cancer risk is at the lower end of the target cancer risk range set by EPA ( $1 \times 10^{-6}$  to  $1 \times 10^{-4}$ ). Using this target is therefore conservative and allows for additive effects from multiple contaminants. However, using the HI of one does not allow for additive effects from multiple chemicals. Therefore, an effort was made to take additive effects into account for noncarcinogens.

For chemicals with noncarcinogenic effects, each sample result was first compared to the RBC calculated using an HI of 0.1 (this is equivalent to the residential RBC divided by 10). Second, the unadjusted RBC was divided by the number of chemicals exceeding the RBC corresponding to an HI of 0.1. For example, if the sample results for five chemicals exceeded the smaller RBC, the unadjusted RBC was divided by five to produce the adjusted RBC. Sample results were then compared to the adjusted RBCs.

This method assumes that each chemical contributes equally to the HI (not a conservative assumption) and that all chemicals exhibit health effects that target the same organ (a conservative assumption). Although these two assumptions are simplistic, the method applied is conservative overall and a more complex analysis and comparison would be inconsistent with the intended purpose of the RBCs.

Residential soil RBCs are not provided for lead. However, the *Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities* (EPA 1994) shown in

Appendix K provides a screening level for lead in residential soil of 400 parts per million (ppm). Similar to RBCs, this screening level is based on human health risk estimates and is subject to the same caveats described above.

As an added conservative measure, the RBC for hexavalent chromium was used instead of the RBC for trivalent chromium. Toxicity values are available for cadmium and manganese in both food and water. For the comparison of RBCs to soil concentrations at the AREE, the RBC derived using the food toxicity value was used (rather than the RBC derived using the water toxicity value).

The Virginia State Water Control Board (SWCB) specifies an action level of 100 ppm for TPH in soils during underground storage tank (UST) removals (VA SWCB 1991). This action level is based on human health risk assessment using broad assumptions regarding the constituents of TPH and will be used for all soils and sediments at VHFS to determine if significant concentrations of TPH exist in the soils.

### ***3.3.2 Sediment Protection Standards***

Contaminant levels in sediments were compared to the Long and Morgan effects range-low (ER-L) and effects range-median (ER-M) values (Long and Morgan 1991). These values are based on studies of various populations of benthic species (e.g., an assemblage of worms, clams, and other invertebrates) that live in the bottom of harbors or estuaries. The ER-Ls and ER-Ms are intended to be used as a screening tool to determine the potential for sediment toxicity. The ER-L corresponds to the contaminant level at which approximately 10 percent of the sensitive species cannot live. The ER-M corresponds to the contaminant level at which approximately 50 percent of the sensitive species cannot live.

### ***3.3.3 Groundwater Protection Standards***

For groundwater, each sample result was compared to EPA Region III tap water RBCs (EPA 1996b) and the Federal drinking water maximum contaminant levels (MCLs) (EPA 1996a). The tap water RBCs are designed to be protective of human health and are generally more restrictive than the MCLs. In addition, the tap water RBCs include contaminants

not regulated under the MCLs. The tap water RBCs are presented in Appendix K. Where necessary, the tap water RBCs were adjusted to take into account additive effects. This adjustment process was the same as that used for comparison of soil concentrations with RBCs and is described in Section 3.3.1. The MCLs are enforceable limits (defined by the Safe Drinking Water Act [SDWA]) for a contaminant in a public water system. Maximum contaminant level goals (MCLGs) also are considered, which are nonenforceable concentrations in drinking water that are designed to be protective of human health with a margin of safety. Both MCLs and MCLGs are presented in Appendix K, and all MCLs and MCLGs that were exceeded are shown in tables in Section 3.6.

The Virginia Department of Environmental Quality (VDEQ) specifies an action level of 1 mg/L for TPH in groundwater during UST removals. Although this action level is not based on human health risk estimates, it will be used for all groundwater and surface water at VHFS to determine if significant concentrations exist.

#### ***3.3.4 Surface Water Protection Standards***

Federal ambient water quality criteria (AWQC) for the protection of freshwater species were applied to surface water only. AWQC for freshwater species are not appropriate references for groundwater, since groundwater does not provide a suitable habitat for freshwater species. All AWQC that are exceeded are shown in tables in Section 3.6. The surface water results also were compared to EPA Region III tap water RBCs because the surface water in the downstream Lake Manassas is used as a public water supply source.

### **3.4 BACKGROUND SAMPLING**

This section presents an analysis of background concentrations detected in soil and groundwater during the SI and provides the rationale for comparison of the background concentrations to detected concentrations in the areas of concern. The background comparison is used to identify the presence of environmental contamination and to assess the magnitude of contamination with respect to uncontaminated conditions. However, in accordance with requests from EPA Region III, the results of the background comparison were not used to decide whether further actions were necessary for each AREE. Methods specified in the EPA guidance



document *Addendum to Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities* (EPA 1992) were used to conduct the background comparison. Background conditions are environmental concentrations that would exist in the absence of treatment, storage, or disposal activities at a site. The background comparison was conducted only for naturally occurring inorganic substances (i.e., total metals), not anthropomorphic organic substances, such as pesticides and polychlorinated biphenyls (PCBs).

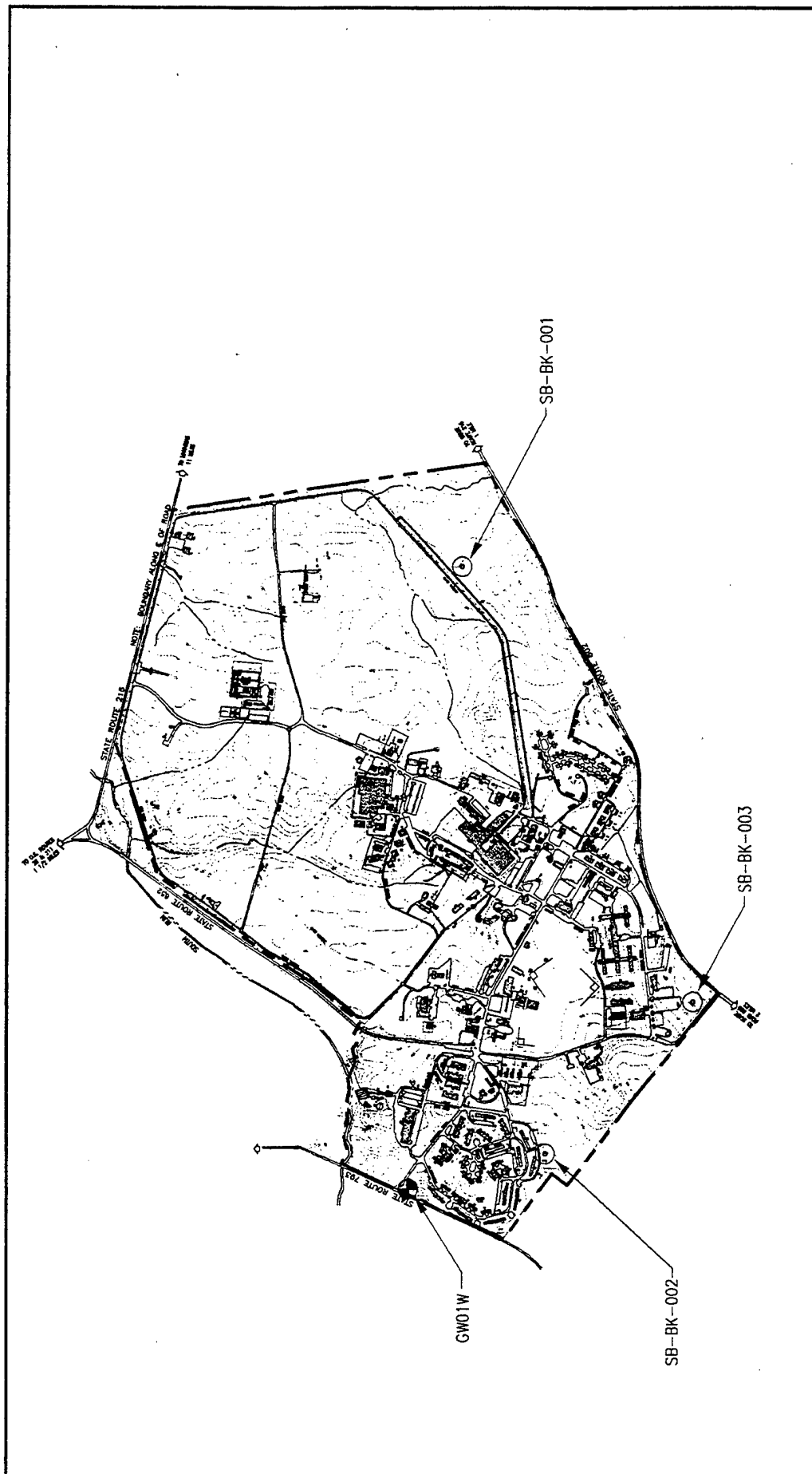
### **3.4.1 Background Sample Results**

The sampling points for background soil and groundwater were located in areas that are not known to have been subjected to waste disposal activities or affected by the activities at the AREEs. The locations of the three soil borings and one groundwater monitoring well are shown in Figure 3-4. Background samples were collected using the same procedures and analytical methods as the samples taken from the AREEs. All sampling, laboratory analyses, and data validation procedures were conducted in accordance with the QAPP (SAIC 1994d).

#### **3.4.1.1 Background Groundwater Sample Results**

Monitoring well GW01W was selected to represent background conditions at VHFS because the well is upgradient of Dump #1 (AREE 1) and was originally installed in 1984 for use as an upgradient reference well (ESE 1986). GW01W is screened in the weathered bedrock (from 23.4 to 37.7 feet BLS) as are all of the other monitoring wells with the exception of GW09W, which is screened in a deeper portion of the shallow aquifer (from 55.4 to 102.4 feet BLS).

The complete results of the laboratory analyses for GW01W are provided in Appendix J. Table 3-2 provides the results for those compounds and analytes detected above the CRL. Nine metals (aluminum, barium, beryllium, calcium, iron, magnesium, manganese, sodium, and thallium) were detected above the CRL. Three pesticides (endosulfan I, endrin ketone, and 4,4'-DDT) were detected at low concentrations. However, each of the detected pesticides was flagged "U," indicating that confirmatory analysis did not detect the presence of the pesticides. In addition, 4,4'-DDT was detected in the associated rinse blank. Therefore, the presence of pesticide compounds in the upgradient monitoring well is suspect. TPH and PCP also were



**LEGEND:**

- ..... BUILDING
- ..... SITE DRAINAGE
- ..... PAVED ROAD
- ..... FENCE
- ..... INSTALLATION BOUNDARY
- ..... BACKGROUND SOIL BORING
- ..... EXISTING BACKGROUND
- ..... GROUNDWATER MONITORING WELL

N

0 750 1500 3000

SCALE: 1" = 1500'

**SAIC**  
Science Applications International Corporation

**VINT HILL FARMS STATION**  
**WARRENTON, VIRGINIA**  
**SI REPORT**

**BACKGROUND SOIL BORINGS AND MONITORING WELLS**

Figure: 3-4 Project: 01-0827-03-6521-060 File Name: 95005\DWGS\036F3204 Date: 03-28-95

**Table 3-2. Data Summary Table: Groundwater - Background**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	GW01W
Field Sample Number	SAIC01
Site Type	WELL
Collection Date	11/18/94
Depth (ft)	22.12

<b>METALSWATER/ICP (SS12, 0010) (ug/L)</b>			
Laboratory ID Number	Units	CRL	UB06357
Parameter	ug/L		
Aluminum	112	231**	
Barium	ug/L 2.82	3.69**	
Beryllium	ug/L 1.12	2.5**	
Calcium	ug/L 105	81600**	
Iron	ug/L 77.5	437**	
Magnesium	ug/L 135	7690**	
Manganese	ug/L 9.67	266**	
Sodium	ug/L 279	11800**	
Thallium	ug/L 2.44	2.93**	

<b>SEMIVOLATILES WATER/GCMS (UM25) (ug/L)</b>			
Laboratory ID Number	Units	CRL	
Parameter	ug/L		
TICs	2 (65.0)		

<b>PHENOLSWATER (0040) (ug/L)</b>			
Laboratory ID Number	Units	CRL	UB06357
Parameter	ug/L		
Pentachlorophenol	1	4.88**	9

**Table 3-2. Data Summary Table: Groundwater - Background  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	GW01W
Field Sample Number	SAIC01
Site Type	WELL
Collection Date	11/18/94
Depth (ft)	22.12

<b>PESTICIDES/WATER/GC/EC (UH20) (ug/L)</b>			
Laboratory ID Number	UB06357		
Parameter	Units	CRL	
Endosulfan I	ug/L	0.003	0.00735** U
Endrin Ketone	ug/L	0.003	0.0444** ZU
4,4'-DDT	ug/L	0.003	0.00574** UG

<b>TRPH/WATER (EPA 418.1) (ug/L)</b>			
Laboratory ID Number	UB06357		
Parameter	Units	CRL	
Total Petroleum Hydrocarbons	ug/L	100	1530**

<b>ANIONS/WATER/IONCHROM (TT09) (ug/L)</b>			
Laboratory ID Number	UB06357		
Parameter	Units	CRL	
Chloride	ug/L	278	8810**
Fluoride	ug/L	153	481**
Sulfate	ug/L	175	27000**

<b>ANIONS/WATER/TECHNICON (LL9) (ug/L)</b>			
Laboratory ID Number	UB06357		
Parameter	Units	CRL	
Nitrite, Nitrate	ug/L	10	650**

<b>INORGANIC/WATER/TECHNICON (TF29) (ug/L)</b>			
Laboratory ID Number	UB06357		
Parameter	Units	CRL	
Phosphate	ug/L	10	65**

**Footnotes:**

- \* - Data collected from chemical transfer file (phase I)
- \*\* - Data collected from USAEC pyramid system (phase III)
- CRL - Certified reporting limit
- ID - Identification
- N/A - not applicable
- TICs - Tentatively Identified Compound: number of TICs (total value)
- Boolean Codes
- LT - Less than the CRL/method detection limit
- Flagging Codes:
  - U - Analysis is unconfirmed.
  - Z - Non-target compound analyzed for and detected (non- GC/MS methods).
  - G - Analyte found in rinse blank as well as field sample.
  - 9 - Non-demonstrated/validated method performed for USAEC.

detected in the groundwater, indicating that petroleum hydrocarbon contamination of the groundwater in the area of GW01W is likely. A housing development for VHFS military personnel is upgradient of the well. No VOCs, SVOCs, cyanide, or herbicides were detected.

Well GW01W was previously sampled in August 1984 for VOCs, cyanide, phenols, and dissolved metals (cadmium, chromium, lead, mercury, and silver). The only contaminants detected during this sampling were mercury at a concentration of 0.3  $\mu\text{g/L}$  and dioctyl phthalate, a common laboratory contaminant, at a concentration of 10  $\mu\text{g/L}$ . The metals sample was filtered prior to analysis. Historical groundwater sampling data are shown in Table 3-3.

Based on the TPH, phenols, and pesticides detected in GW01W, the well was not considered to be indicative of the background groundwater at VHFS. Therefore, the comparison between the GW01W inorganic results and the other monitoring well inorganic results was not conducted. Instead, upgradient wells were installed at five of the AREEs during the supplemental sampling event to provide a background comparison for those particular wells. Groundwater results at the other AREEs were evaluated without a background comparison. Further action to investigate the source of contamination in GW01W is discussed in Section 4.

#### **3.4.1.2 Background Soil Sample Results**

Background soil samples were collected from three locations, each of which appears to be unaffected by any of the AREEs or any other contaminant source (based on historical information). One soil boring was drilled within each of the three surficial geologic zones—Jurassic/Triassic Catharpin Creek Member (SB-BK-001), Jurassic/Triassic Sander Basalt (SB-BK-002), and Jurassic/Triassic Hickory Grove Basalt (SB-BK-003).

According to previous geologic information, the unconsolidated residual material ranges from 20 to 40 feet BLS in the southern portion of VHFS. However, the borings encountered bedrock at depths shallower than expected—6.5 feet at SB-BK-001, 6 feet at SB-BK-002, and 23.5 feet at SB-BK-003. Only one soil sample was collected at SB-BK-002 due to its shallow depth, while two soil samples were collected at SB-BK-001 and SB-BK-003. All soil samples

Table 3-3. Historical Groundwater Well Sampling Data  
Vint Hill Farms Station, Warrenton, Virginia

Well ID	Sample Date <sup>1</sup>	Parameter	Concentration (µg/L)	Flagging Code
GW01W	8/1/84	di-n-octyl phthalate	10.000	None
GW01W	8/1/84	mercury	0.308 <sup>3</sup>	None
GW02W	8/2/84	methylene chloride	4.000	S <sup>2</sup>
GW02W	8/2/84	di-n-octyl phthalate	20.000	None
GW02W	8/2/84	mercury	0.338 <sup>3</sup>	None
GW03W	8/2/84	bis(2-ethylhexyl)phthalate	60.000	S <sup>2</sup>
GW03W	8/2/84	di-n-octyl phthalate	60.000	None
GW03W	8/2/84	lead	16.100 <sup>3</sup>	None
GW04W	8/2/84	di-n-octyl phthalate	20.000	None
GW04W	8/2/84	mercury	0.489 <sup>3</sup>	None
GW05W	8/2/84	lead	15.100 <sup>3</sup>	None
GW06W	8/2/84	mercury	0.308 <sup>3</sup>	None
GW07W	8/2/84	mercury	0.489 <sup>3</sup>	None
GW09W	8/2/84	lead	22.200 <sup>3</sup>	None

Notes:

- <sup>1</sup> - Wells were sampled by ESE as part of the installation assessment (ESE 1986).
- <sup>2</sup> - Non-target compound analyzed for and detected (GC/MS methods).
- <sup>3</sup> - Sample filtered prior to analysis.

Source: Analytical data from IRDMIS.

were composed of yellow, red, or brown silt and clay with the exception of the deep soil sample from SB-BK-001 (5.0 to 6.5 feet BLS), which was composed of weathered bedrock.

The results of the laboratory analyses for the three background soil borings are provided in Appendix J. Table 3-4 provides the results for those contaminants detected above the CRL. All metals were detected in the background soils with the exception of selenium, cadmium, silver, and thallium. The dioxin octachlorodibenzo-p-dioxin (OCDD) was detected in all three soil borings. The dioxin, a product of incomplete combustion, may have been deposited on the soils as a result of previous burning activities: the former steam plant (Building 161) near SB-BK-003, the former burn pile near SB-BK-001, and Dump #1 trash burning near SB-BK-002. No VOCs, SVOCs, PCBs, TPH, pesticides, herbicides, or cyanide were detected in the background soils.

Soil samples from SB-BK-001 (3 feet BLS), SB-BK-002 (3 feet BLS), SB-BK-003 (5 feet BLS), and SB-BK-003 (18.5 feet BLS) are included in the background data set. The soil sample from SB-BK-001 (5 feet BLS) was excluded from the background comparison because it was of a soil type (saproelite) that was not represented by any of the soil samples collected from any of the AREEs (i.e., primarily yellowish-red silts and clays).

#### ***3.4.2 Identification of Contaminants Using the Background Comparison***

Two statistical methods are used in the comparison of site-specific results to background results. These comparisons are intended to determine if concentrations at an AREE are statistically different from concentrations in background.

The t-test (or Mann-Whitney test) compares the central tendencies (i.e., the means) of the AREE and background data sets. The upper tolerance limit (UTL) test compares analytical results from each AREE to an upper limit on a percentile of the background data set. The methods differ in that the t-test compares the means of the data sets whereas the UTL test compares individual sample concentrations to a representative background concentration. The UTL provides an additional point of reference in the background comparison and can help clarify the results of the t-test. For example, if the t-test indicates a difference in the AREE and

**Table 3-4. Data Summary Table: Soil - Background**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SB-BK-001	SB-BK-002	SB-BK-003	SB-BK-003
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC02
Site Type	BORE	BORE	BORE	BORE
Collection Date	11/8/94	11/8/94	11/8/94	11/8/94
Depth (ft)	3	3	5	18.5

<b>METALS/SOIL/CFAA (Y9) (ug/g)</b>				
Laboratory ID Number	UB06192	UB06193	UB06194	UB06202
Parameter	Units	CRL	LT	LT
Mercury	ug/g	0.05**	0.0703**	0.06**
				0.05**

<b>METALS/SOIL/GFAA (B9, JD20, JD21) (ug/g)</b>				
Laboratory ID Number	UB06192	UB06193	UB06194	UB06202
Parameter	Units	CRL	LT	LT
Arsenic	ug/g	2.5**	2.5**	2.5**
Lead	ug/g	11.3**	13**	7.18**
				1.88**

<b>METALS/SOIL/ICP (JS12) (ug/g)</b>				
Laboratory ID Number	UB06192	UB06193	UB06194	UB06202
Parameter	Units	CRL	LT	LT
Aluminum	ug/g	11.2	24900**	60600**
Barium	ug/g	3.29	31.3**	310**
Beryllium	ug/g	0.427	0.624**	5.1**
Calcium	ug/g	25.3	254**	2120**
Cobalt	ug/g	2.5	8.62**	52.8**
Chromium	ug/g	1.04	75.6**	60.7**
Copper	ug/g	2.84	17.9**	76.8**
Iron	ug/g	6.66	91000**	180000**
Potassium	ug/g	131	280**	254**
Magnesium	ug/g	10.1	620**	4040**
Manganese	ug/g	9.87	216**	151**
Sodium	ug/g	38.7	38.7**	78.1**
Nickel	ug/g	2.74	7.4**	31**
Vanadium	ug/g	1.14	270**	531**
Zinc	ug/g	2.34	32.2**	247**



Table 3-4. Data Summary Table: Soil - Background  
Vint Hill Farms Station, Warrenton, Virginia (Continued)

Site ID	SB-BK-001	SB-BK-002	SB-BK-003	SB-BK-003
Field Sample Number	SAIC02	SAIC01	SAIC01	SAIC02
Site Type	BORE	BORE	BORE	BORE
Collection Date	11/8/94	11/8/94	11/9/94	11/9/94
Depth (ft)	3	3	5	18.5

SEMIVOLATILES/SOIL/OCMS (LM25) (ug/g)				
Laboratory ID Number	Parameter	Units	CRL	
	TiCs	ug/g	3 (2.5)	4 (2.5) 3 (2.2) 3 (2.3) 5 (3.1)

DIOXIN/FURANS/SOIL (2210) (pg/g)				
Laboratory ID Number	Parameter	Units	CRL	
078566-0005-SA				078566-0006-SA 078566-0007-SA 078566-0009-SA 078566-0010-SA
OCDD		ng/g	0.59Z	0.68Z 3.8 1.8 ND 0.13

Footnotes:

- \* - Data collected from chemical transfer file (Phase I)
- \*\* - Data collected from USAEC Pyramid system (Phase III)
- \*\*\* - Data from this sample were not used in the background comparison.
- \*\*\*\* - Sample specific estimated detection limit.
- CRL - Certified reporting limit
- ID - Identification
- N/A - Not applicable
- QC - Quality control
- TiCs - Tentatively Identified Compound: number of TiCs (total value)
- Boolean Codes
- LT - Less than the certified reporting limit/method detection level
- ND - Not detected
- Flagging Codes:
- Z - Result detected is below the lowest standard and above zero.

background data sets, the UTL test may help indicate whether the AREE concentrations exceed the background concentrations, or vice versa.

Only validated data from the IRDMIS data base were used in the background comparison. Duplicate samples were treated as QC samples, and thus not included in the statistical analysis.

In order to make comparisons using either the t-test or the UTL test, both the sample data set and the background data set must be comparable in terms of their data distributions. This is important, since normal statistics are used only with normal distributions, whereas nonparametric tests can be used for any distribution. Therefore, the sample data (soil and groundwater) from each AREE and from the background locations were evaluated to determine the underlying distribution.

Goodness-of-fit tests were used to determine whether the sample distributions were or were not normally distributed. A modification of the Kolmogorov-Smirnov one-sample test, the Lilliefors test, was conducted using SYSTAT® (SYSTAT® 1992). This test arranges the sample data in rank order and compares the cumulative frequencies of the sample distribution to those of the standard normal frequency distribution. The test result is the maximum deviation between these compared cumulative frequencies. The test was conducted using both the untransformed sample data and the transformed (natural log) sample data. Four outcomes are possible:

- The background and the AREE data sets are normally distributed
- The background and the AREE data sets are lognormally distributed
- One data set is normal while the other is lognormal
- One or both data sets are neither normal or lognormal.

If both the background and the AREE data sets were normal or if both were lognormal, the t-test and the UTL test were conducted. If both were lognormal, the data were first transformed and the background comparison was conducted in log space. If the sample sets were different from one another, or if one or both were neither normal nor lognormal, a nonparametric equivalent to the t-test, the Mann-Whitney test, was used.

### 3.4.2.1 The Two-Sample t-test and the Mann-Whitney test

As stated previously, the t-test is a method in which the mean of the AREE data set is compared to the mean of the background data set. Two outcomes of this comparison are possible, as expressed by the following two hypotheses:

$H_0$  = Null hypothesis = there is no difference between site and background

$H_A$  = Alternate hypothesis = there is a difference between site and background.

In other words, the null hypothesis indicates no contamination, and the alternate hypothesis indicates the existence of contamination. As discussed in EPA guidance (EPA 1992), a minimum of four samples in either data set is recommended to conduct tests that compare the central tendencies of distributions (i.e., the t-test or Mann-Whitney test). The t-test is based on the following formula:

$$t = \frac{X_1 - X_2}{S_{X1-X2}}$$

where

$X_1$  = Mean of first data set

$X_2$  = Mean of second data set

$S_{X1-X2}$  = Difference in the standard deviations of the two data sets.

The t-test results in a value that is compared to values in a standard t table. The table indicates a certain probability (described below) associated with the value, depending on the sample size (i.e., degrees of freedom). When using statistical software (in this case SYSTAT®), this probability is automatically generated.

The t-test is applicable if both the AREE samples and the background samples are both normally distributed, or are both lognormally distributed. If the central tendencies of the distributions differ (e.g., one is normal and the other is lognormal, one or both is neither normal

nor lognormal), the t-test is not used and a nonparametric test is used instead. The Mann-Whitney test is the nonparametric analogue to the two-sample t-test.

The Mann-Whitney test uses the ranks of the sample data rather than their values. The largest value is assigned the rank of 1, the next greatest is assigned a rank of 2, and so on. The smallest value would then have the following rank:

$$N = n_1 + n_2$$

where

- $n_1$  = The number of observations (i.e., samples) in sample set 1
- $n_2$  = The number of samples in sample set 2.

The Mann-Whitney statistic is then calculated using the following equation, and compared to a table in a manner analogous to the t-test:

$$U = n_1 n_2 + \frac{n_1(n_1 + 1)}{2} - R_1$$

where

- $n_1$  = The number of observations (i.e., samples) in sample set 1
- $n_2$  = The number of samples in sample set 2
- $R_1$  = The sum of the ranks of the observations in sample set 1.

There is always some chance of making an error (selecting the wrong hypothesis). Because of this, a decision regarding an acceptable error rate must be selected. This background comparison uses the conventional type I error rate of 5 percent, which means that the maximum allowable probability of erroneously rejecting the null hypothesis (and thereby wrongly selecting the alternate hypothesis) is 1 event in 20. The result of the t-test is expressed as the probability of this occurring (type I error). If the probability is below 5 percent, we can confidently reject

the null hypothesis and conclude that there is a difference in the central tendencies of the compared distributions. Conversely, if the probability of type I error is above 5 percent, we accept the null hypothesis and conclude that there is no difference between site and background. To summarize:

- p-value above 0.05 indicates no difference between site and background
- p-value below 0.05 indicates a difference between site and background.

#### 3.4.2.2 The Upper Tolerance Limit

As an additional point of comparison, the UTL is used to define an upper acceptable limit for the background data set. The UTL is an upper confidence limit for a proportion (or percentile) of the background data set. In this case, it is the concentration below which 95 percent of the background samples fall, with a 95 percent confidence level. Samples from the AREE data set with concentrations above the UTL provide an indication of site contamination.

The UTL is calculated using the following formula (EPA 1992):

$$UTL = \bar{x} + ks$$

where

- $\bar{x}$  = Mean of the background data set
- $k$  = One-sided normal tolerance factor from standard  $k$  table
- $s$  = Standard deviation of background data set.

If any one sample result from an AREE exceeds the background UTL, there is evidence of concentrations exceeding background.

When calculating the UTL for small data sets (as is presently the case), on some occasions the estimate of the UTL for the background data set will exceed the maximum of that

sample data set. This is due to the considerable variability that is often encountered when preparing statistics for small data sets. In cases where the UTL for a given analyte is found to exceed the maximum, the maximum value (for that analyte) in the background sample set has been substituted as the background UTL (for that analyte).

#### **3.4.2.3 Background Comparison for Groundwater**

A statistical background comparison was not conducted for groundwater. The background well (GW01W) was not found to be representative of background conditions because TPH, phenols, and pesticides were detected in the well. In addition, given the few groundwater samples that are available for the background and AREEs, the UTL test and statistical approaches that rely on comparison of the central tendencies of two sample distributions (i.e., the t-test or Mann-Whitney test) are not accurate. Instead, a simple comparison was made of chemical concentrations in downgradient well(s) with concentrations in the upgradient well within an AREE, if available.

#### **3.4.2.4 Background Comparison for Soil**

The background comparison for soils included the t-test (or Mann-Whitney test) and the UTL test. In cases where there were too few samples collected at an AREE to perform the t-test, only the UTL test was conducted. There are four possible outcomes when considering the results of the two tests:

- *Outcome 1.* t-test indicates no difference, and UTL test indicates no difference
- *Outcome 2.* t-test indicates difference, and UTL test indicates no difference
- *Outcome 3.* t-test indicates no difference, and UTL test indicates difference
- *Outcome 4.* t-test indicates difference, and UTL test indicates difference.

Outcome 1 provides reasonably strong evidence that there is no difference between the AREE and background (i.e., no contamination in a given medium at the AREE). Outcomes 2 and 3 provide some evidence that there may be contamination, but since the two tests conflict with one another, the results are equivocal. Outcome 4 provides the strongest evidence of contamination relative to the other possible outcomes.

There is a fifth outcome to consider. When there are too few samples collected at an AREE to conduct a t-test (i.e., fewer than four samples), only the UTL test is conducted. Because there is no t-test to provide an additional point of comparison, conclusions are based only on the UTL test. Because of the small sample size, the results are somewhat less certain than if more samples were available.

### ***3.4.3 Results of Background Comparison***

Results of the background comparison consist of the probabilities generated by the t-test, and whether or not any samples exceed the background UTL. These results are shown in detail in Appendix L, and are summarized in the data analyses tables for those analytes that exceed the RBCs in Section 3.6. If there were too few samples collected at an AREE to conduct the t-test for soil, only the UTL test was conducted. In the case of groundwater, a statistical background comparison was not conducted. This is due to a lack of confidence that well GW01W is representative of background conditions and because there are too few samples available to conduct statistical tests for the background comparison.

Sample results from the groundwater probes had notably higher concentrations of inorganic substances (in some cases 100 or 1,000 times higher) than for conventional monitoring wells in the same AREE. This is because the probes have no filter packs to prevent soil particles from entering the well. When the groundwater sample was preserved with nitric acid, the dissolution of metals adsorbed to soil particles occurred, which resulted in abnormally high metals concentrations. For this reason, inorganic sample results from the probes have been excluded from the background comparison.

### ***3.4.4 Comparison with Regional Data***

Regional data on concentrations of metals in soils from the eastern United States (Shacklette and Boerngen 1984) were used to help determine if sample results from the SI indicated the presence of contamination or if metals concentrations were naturally occurring. The geometric mean, standard deviation, and observed range of all metals detected at the AREEs during the SI are listed in Table 3-5. If the metals concentration exceeded background as

**Table 3-5. Regional Data for Soil Samples from the Eastern United States  
Vint Hill Farms Station, Warrenton, Virginia**

<b>Element</b>	<b>Geometric Mean (<math>\mu\text{g/g}</math>)</b>	<b>Geometric Deviation (<math>\mu\text{g/g}</math>)</b>	<b>Observed Range (<math>\mu\text{g/g}</math>)</b>
Aluminum	33,000	28,700	7,000 - >100,000
Arsenic	4.8	2.56	<0.1 - 73
Barium	290	2.35	10 - 1,500
Beryllium	0.55	2.53	<1-7
Calcium	3,400	30,800	100-280,000
Chromium	33	2.60	1 - 1,000
Cobalt	5.9	2.57	<0.3 - 70
Copper	13	2.80	<1 - 700
Iron	14,000	28,700	100->100,000
Lead	14	1.95	<10-300
Magnesium	2,100	35,500	50-50,000
Manganese	260	3.82	<2 - 7,000
Mercury	0.081	2.52	0.01 - 3.4
Nickel	11	2.64	<5-700
Potassium	12,000	7,500	50 - 37,000
Selenium	.30	2.44	<0.1-3.9
Sodium	2,500	45,500	<500-50,000
Thallium	7.7	1.58	2.2-23
Vanadium	43	2.51	<7-300
Zinc	40	2.11	<5 - 2,900

SOURCE: Shacklette and Boerngen 1984



indicated by the t-test or UTL test, a comparison using the regional data was performed. However, regional data were not used to exclude metals from consideration.

Arsenic, a naturally occurring non-metallic inorganic, was detected at most of the AREEs above the residential soil RBC of  $0.37 \mu\text{g/g}$ . According to the t-test and UTL test, because arsenic was not detected in the background soils, any detection of arsenic would exceed background. However, as shown in Table 3-5, the natural distribution of arsenic has a geometric mean of  $4.8 \mu\text{g/g}$  and a geometric deviation of  $2.56 \mu\text{g/g}$ . Thus, the residential soil RBC would be exceeded naturally for most areas within the United States. The regional data on arsenic from the eastern United States approximates a normal distribution (Shacklette and Boerngen 1984). According to statistical methods, 95 percent of all arsenic concentrations will be within two deviations ( $5.12 \mu\text{g/g}$ ) of the mean ( $4.8 \mu\text{g/g}$ ). Therefore, because the UTL test is based on a percentile of 95 percent, arsenic concentrations below  $9.92 \mu\text{g/g}$  were considered to be within the regional observed range.

### **3.5 STREAMLINED RISK ASSESSMENT**

The purpose of the streamlined risk assessment is to supplement the SI Report by providing further support for the no further action (NFA) decisions and, therefore, was only performed for select AREEs where NFA recommendations were made. The risk assessment is streamlined in scope, as recommended in project-specific meetings with VDEQ and EPA Region III and as agreed upon in teleconferences with VDEQ and EPA Region III, held November 30 and December 12, 1995. The methods used in this document are consistent with VDEQ guidance on streamlined risk assessment (VDEQ 1995) and methods developed by EPA under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) programs (EPA 1989c, EPA 1991b).

#### **3.5.1 Data Collection**

Chemicals of potential concern (COPCs) are designated as all of the chemicals that were detected in soil or groundwater. No attempt has been made to screen or otherwise reduce the data set, other than to use only the maximum detected values. A comparison to RBCs and to

background concentrations has been conducted in this report, although these comparisons are not used in the risk assessment.

### 3.5.2 Exposure Assessment

The potential for human contact with contaminated soil and groundwater is evaluated in the exposure assessment. In this assessment, exposure pathways and the components that comprise an exposure pathway are examined:

- The *exposure pathway* is the physical process by which such contact occurs; the requisite condition for a complete exposure pathway is the convergence of the receptor (or receptors) and toxic chemicals.
- The *receptor* is a human child or an adult; ecological effects are not evaluated in this case.
- The location at which contact with toxic chemicals occurs is the *exposure point*.
- The area within which the exposure occurs is the *exposure unit*.
- The concentration to which a receptor is exposed is represented by the *exposure point concentration*.
- The *exposure route* is the means by which a contaminant exposure is applied to the receptor.

The following is an example of the use of these concepts. A contaminant source exists for which there is no direct contact to a receptor. The contaminant source area is not an exposure point, and as such, this represents an incomplete exposure pathway; there is no exposure at the source area. If, however, surface water runoff has carried contaminants away from the source area, a complete exposure pathway may exist if contaminants have migrated to an exposure point. Exposure to a receptor such as a child playing in the soil at the exposure point may then occur via incidental ingestion of the translocated contaminants in soil.

The observed levels of analytes at the NFA AREEs at VHFS are low or nonexistent, indicating that the potential for migration (e.g., surface runoff, air, etc.) is minimal. In terms of a conceptual model, exposures are limited to direct contact exposures at the sample point (e.g., single point maximum values were used). No transport modeling is necessary or used in the analysis.

### **3.5.2.1 Current and Future Land Use**

Both current and future land uses at VHFS are examined in the risk assessment. Under current land use, only limited potential for exposure exists, whereas in the future, more sensitive land uses may prevail that could convey higher levels of exposure. A land use plan is available for VHFS that indicates residential land use is unlikely at each of the NFA AREEs. Less sensitive industrial or commercial land use (i.e., exposure to workers) is more likely than residential (i.e., exposure to resident children and adults).

As a conservative measure, both likely and unlikely land uses are considered. Under current land use, this includes:

- VHFS worker
- Construction worker.

In the future, more sensitive residential land use includes:

- Resident child
- Resident adult.

Given the existence of a comprehensive land use plan for VHFS, exposures considered under current land use are considered the most reasonable representation of future land uses (i.e., residential land use near NFA recommended AREEs is unlikely).

### **3.5.2.2 Exposure Pathways**

In keeping with the prescribed streamlined approach for this risk assessment, both quantitative and qualitative techniques are used.

#### *Quantitative Analysis:*

- Ingestion pathway for soil
- Ingestion pathway for groundwater

### *Qualitative Analysis:*

- Dermal pathway
- Inhalation pathway.

#### **3.5.2.3 Data Aggregation - Exposure Units**

Each of the NFA AREEs has been evaluated as a separate exposure unit in the risk assessment. Simply stated, an exposure unit may be thought of as an area in which a receptor accumulates or averages an exposure. In the case of soil, it is a geographic area that is represented by the soil data. For groundwater, it is the portion of an aquifer through which contaminants are migrating (e.g., a contaminant plume). In this case, the data used in the risk assessment are a single data point, the maximum detected value for each detected analyte. The underlying assumption is that the receptor is exposed at the maximum detected concentration. This is inherently a very conservative approach that is likely to overstate risks. The exposure units for the risk assessment correspond to the AREEs themselves, and include:

- AREE 2 (soil)
- AREE 5 (soil and groundwater)
- AREE 7 (soil)
- AREE 10 (soil)
- AREE 12 (groundwater)
- AREE 13 (soil)
- AREE 20 (soil)
- AREE 21 (soil) Outside Sand Filter Beds
- AREE 21 (soil) Inside Sand Filter Beds
- AREE 24 (soil)
- AREE 26 (soil) Current Vehicle Wash Racks
- AREE 26 (soil) Former Vehicle Wash Racks
- AREE 29-2 (soil).

In the case of soil at AREE 21, the data from two distinct areas were aggregated separately: inside the sand filter beds and outside the sand filter beds. In a similar manner for AREE 26, the data from the former vehicle wash racks were analyzed separately from that of the current vehicle wash racks.

### 3.5.2.4 Dose Estimates

Dose estimates have been prepared for soil and groundwater ingestion pathways. They represent the average daily dose encountered over the duration of the exposure, and are calculated as follows:

$$Dose_{\text{Soil Ingestion}} = C_{\text{Soil}} \times \frac{CF \times IR_{\text{Soil}} \times EF \times ED}{BW \times AT}$$

$$Dose_{\text{Groundwater Ingestion}} = C_{\text{Groundwater}} \times \frac{IR_{\text{Groundwater}} \times EF \times ED}{BW \times AT}$$

where:

Dose	= Dose estimate (mg/kg)/day or mg/(kg · day)
$C_{\text{Soil}}$	= Concentration of chemical in soil (mg/kg)
$C_{\text{Groundwater}}$	= Concentration of chemical in groundwater (mg/L)
CF	= Conversion factor for soil (kg/1 x 10 <sup>6</sup> mg)
$IR_{\text{Soil}}$	= Ingestion rate for soil (mg/day)
$IR_{\text{Groundwater}}$	= Ingestion rate for groundwater (L/day)
EF	= Exposure frequency (days/year)
ED	= Exposure duration (years)
BW	= Body weight (kg)
AT	= Averaging time (days).

### 3.5.2.5 Exposure Parameters

The values for the exposure parameters used in the dose estimate equations are provided in Table 3-6.

**Table 3-6. Exposure Parameters for Current and Future Land Use  
Vint Hill Farms Station, Warrenton, Virginia**

Pathway Parameter	Units	Current Land Use		Future Land Use	
		Station Worker	Construction Worker	Resident Child	Resident Adult
Soil Ingestion Rate	mg/day	50 (a)	480 (a)	200 (a)	100 (a)
Groundwater Ingestion Rate	L/day	--	--	1 (a)	2 (a)
Exposure Frequency	days/year	250 (b)	250 (c)	350 (d)	350 (e)
Exposure Duration	years	25 (b)	3 (c)	6 (d)	30 (e)
Body Weight	kg	70 (a)	70 (a)	15 (a)	70 (a)
Averaging Time (Noncancer Effects)	days	9,125	1,095	2,190	10,950
Averaging Time (Cancer effects)	days	25,550	25,550	25,550	25,550

(a) - EPA 1993.

(b) - Exposure frequency and duration for the Station Worker based on 5 days/week for 50 weeks/year for 25 years.

(c) - Exposure frequency and duration for the Construction Worker based on 5 days/week for 50 weeks/year for 3 years.

(d) - Exposure frequency and duration for the resident child is based on 7 days/week for 50 weeks/year for 6 years.

(e) - Exposure frequency and duration for the resident adult is based on 7 days/week for 50 weeks/year for 30 years.

### 3.5.3 Toxicity Assessment

The toxic effects considered in this risk assessment are expected as a result of low, not high, level exposures over longer (chronic) time periods. The types of toxic effects that may be expected under such conditions are listed below. The chemicals included in this list are the most important ones at any of the AREEs, based on a preview of the risk assessment results (presented below):

#### Arsenic

- Nausea, vomiting, diarrhea
- Decreased production of red and white blood cells

- Abnormal heart rhythm
- Blood vessel damage
- A "pins and needles" sensation in hand and feet
- Darkening of skin, and "corns" or "warts" in the palms, soles, and torso
- Inhalation can lead to lung cancer
- Ingestion can lead to cancer and tumors of the bladder, kidney, liver, and lung.

#### Beryllium

- Allergies resulting in feeling weak and tired, breathing difficulties
- Rashes or ulcers on scraped or cut skin
- Oral ingestion is not associated with toxic effects.
- Inhalation is associated with lung cancer.

#### Manganese

- Oral ingestion is associated with effects to the central nervous system
- Neurobehavioral effects
- Not associated with cancer effects.

#### Vanadium

- Low-level exposures are not associated with any particular toxic effects
- Not associated with cancer effects.

### **3.5.4 Risk Characterization**

The risk characterization is streamlined, focusing on the results of the risk assessment. Only ingestion risks are evaluated quantitatively. Risks related to the dermal exposure may be considered to be similar, although typically lower than the ingestion risks. Inhalation risks for exposure to volatile substances is not of concern, since volatile chemicals are not prevalent at any of the NFA AREEs. Given the presence of a vegetative cover and relatively low potential for dust generation under normal conditions, inhalation risks related to particle bound

contaminants (dust) are likely to be at least one order of magnitude lower than the ingestion risks.

A brief discussion is warranted on interpreting and judging the significance of the risk characterization results. The health effects considered in the risk characterization are divided into two types (i.e., noncancer and cancer).

#### 3.5.4.1 Noncancer Effects

Noncancer effects include all effects other than those associated with cancer. For noncancer effects, there is a threshold exposure above which toxic effects are manifested and below which toxic effects are not shown. The toxic effects are quantified by comparing the average daily dose for a given chemical to a reference dose (RfD) for that chemical. Note that the dose for evaluating noncancer effects is different from the dose used to evaluate cancer effects (i.e., the averaging times are different). The RfD is published by EPA (EPA 1995a, EPA 1995b).

The ratio of the dose estimate to the RfD is the hazard quotient (HQ) for a given chemical. If the HQ is above 1, there may be unacceptable adverse noncancer health effects. Greater exceedances of 1 indicate greater potential for noncancer toxic effects. Where multiple chemicals are present, the sum of all the HQs is known as the hazard index (HI). The benchmark for the HI is also 1. The HI is meaningful only if the individual HQs are additive (i.e., if the toxic effect of each chemical is similar to one another). This issue (i.e., additivity) was discussed and agreed upon with VDEQ and EPA Region III during the teleconferences of November 30 and December 12, 1995.

$$HI = \frac{Dose_{Noncancer\ effects}}{RfD}$$



#### 3.5.4.2 Cancer Effects

In contemporary risk assessments, cancer effects are assumed not to have a toxic threshold below which no effects are expected. Even small doses can accumulate over a lifetime. Cancer effects also are assumed to be additive regardless of the target organ or site of the effect. Cancer risk estimates differ from noncancer estimates in that cancer risks are probabilistic estimates (i.e., 1 chance in 1 million for a cancer effect such as a tumor, expressed as  $1 \times 10^{-6}$ ). In this SI, cancer risks less than  $1 \times 10^{-6}$  are considered acceptable; cancer risks falling between  $1 \times 10^{-6}$  and  $1 \times 10^{-4}$  are considered within the target cancer risk range; and cancer risks greater than  $1 \times 10^{-4}$  are considered chemicals of concern (COCs) that may require further investigation or remediation.

Cancer risks are estimated for each carcinogenic chemical as the product of the cancer effects dose and the cancer slope factor (CSF) for that chemical, as follows:

$$\text{Cancer risk} = \text{CSF} \times \text{Dose}_{\text{Cancer effects}}$$

The CSFs are published by EPA (EPA 1995a, EPA 1995b).

#### 3.5.4.3 Results of the Risk Characterization

The results of the risk assessment for the soil and groundwater exposure units are presented in Section 3.6 under the discussion for each AREE and summarized in Section 4. More detailed, chemical-specific risk estimates are provided in Appendix M.

#### 3.5.5 Uncertainties

In accordance with the streamlined risk assessment, the uncertainty analysis is concerned only with a few important issues, and does not cover some of the more broad issues analysis (e.g., uncertainty in the toxicity values) or the latest trends in quantitative uncertainty analysis.

#### 3.5.5.1 Additivity

Cancer effects are associated with arsenic and beryllium, since each is associated with lung cancer via the inhalation route. This risk assessment does not quantitatively consider the inhalation route. However, the minimal inhalation exposure to these metals in soil at the detected (i.e., low) levels would likely produce cancer effects that are lower in magnitude than the cancer effects via the ingestion route. Because the cancer risk estimates for ingestion are low, noncancer effects should be the focus of environmental decisions for these AREEs.

The noncancer toxic effects of the most significant substances (arsenic, beryllium, manganese, and vanadium) do not appear to be directly comparable. Although the HI for each AREE is shown in the risk estimate as a conservative measure, the oral HQs should be considered to be independent of one another. In this light, none of the HQs for any of these chemicals is above 1 with the exception of the child ingestion HQ for manganese at AREE 5 (based on a maximum concentration of 3,200 mg/kg).

#### 3.5.5.2 Other Issues

Land use at the NFA AREEs is unlikely to change to residential, as indicated in the existing land use plan for VHFS. The residential land use scenario is highly unlikely, and was included for the purpose of providing highly conservative and hypothetical risk estimates.

The use of the maximum detected values for the COPCs is an effort to ensure conservatism, given that this is a streamlined risk assessment and the data sets are generally small. The tendency to overestimate risk by using maximum values is intended to provide a margin of safety for decisions based on the information provided in the SI and the risk assessment.

EPA-approved toxicity values are not available for aluminum and iron. For aluminum, a provisional RfD is available from the EPA National Center for Environmental Assessment in Cincinnati, Ohio. EPA Region III has indicated, however, that the primary toxic endpoint for aluminum is developmental, and that its use would not be appropriate for evaluating child and adult exposures as specified for the streamlined risk assessment. For iron, there also is a provisional RfD, but its use is controversial and is not recommended by a contact person listed

on the Integrated Risk Information System (IRIS) data base (EPA Region VIII [1996c], personal communication). Therefore, the streamlined risk assessment has not quantitatively evaluated risk associated with these analytes. However, the naturally occurring levels of aluminum and iron in the VHFS area are high (up to 60,600 and 180,000  $\mu\text{g/g}$ , respectively, in the background soil samples). Neither aluminum nor iron appear to be site-related contaminants. Because of this, and the very weak evidence of toxic effects at the observed concentrations, the exclusion of these two metals is unlikely to underestimate the risks.

The risk assessment provided only one point estimate for each receptor. This estimate is the reasonable maximum exposure (RME), with the additional conservative use of the maximum detected contaminant levels. Estimates of central tendency exposure (CTE), which are average and more realistic estimates of exposure and risk, were not included. It is important to recognize that these risk estimates are thus biased toward overestimation of risk.

### **3.6 AREE-SPECIFIC RESULTS**

The specific results for the soils, sediments, groundwater, and surface water from each AREE are presented below. An assessment of the significance of the results is based on the compounds detected at concentrations exceeding protection standards (e.g., the residential soil RBCs) and above background levels, if available. Further actions are based on the significance of contaminants found, the PARCC of the data, and the past site history.

Results for samples from the groundwater probes had notably higher concentrations of metals (in some cases 100 or 1,000 times higher) than for conventional monitoring wells in the same AREE. This is because the probes have no sand filter packs to prevent soil particles from entering the well. When the groundwater sample was acidified with nitric acid, the dissolution of metals adsorbed to soil particles occurred, which resulted in abnormally high metals concentrations. For this reason, inorganic sample results from the groundwater probes are considered uncharacteristic of the true groundwater condition and were excluded from the protection standards comparisons. However, results for organic analytes from the probes were consistent with results from conventional monitoring wells and were included in the protection standards comparisons.

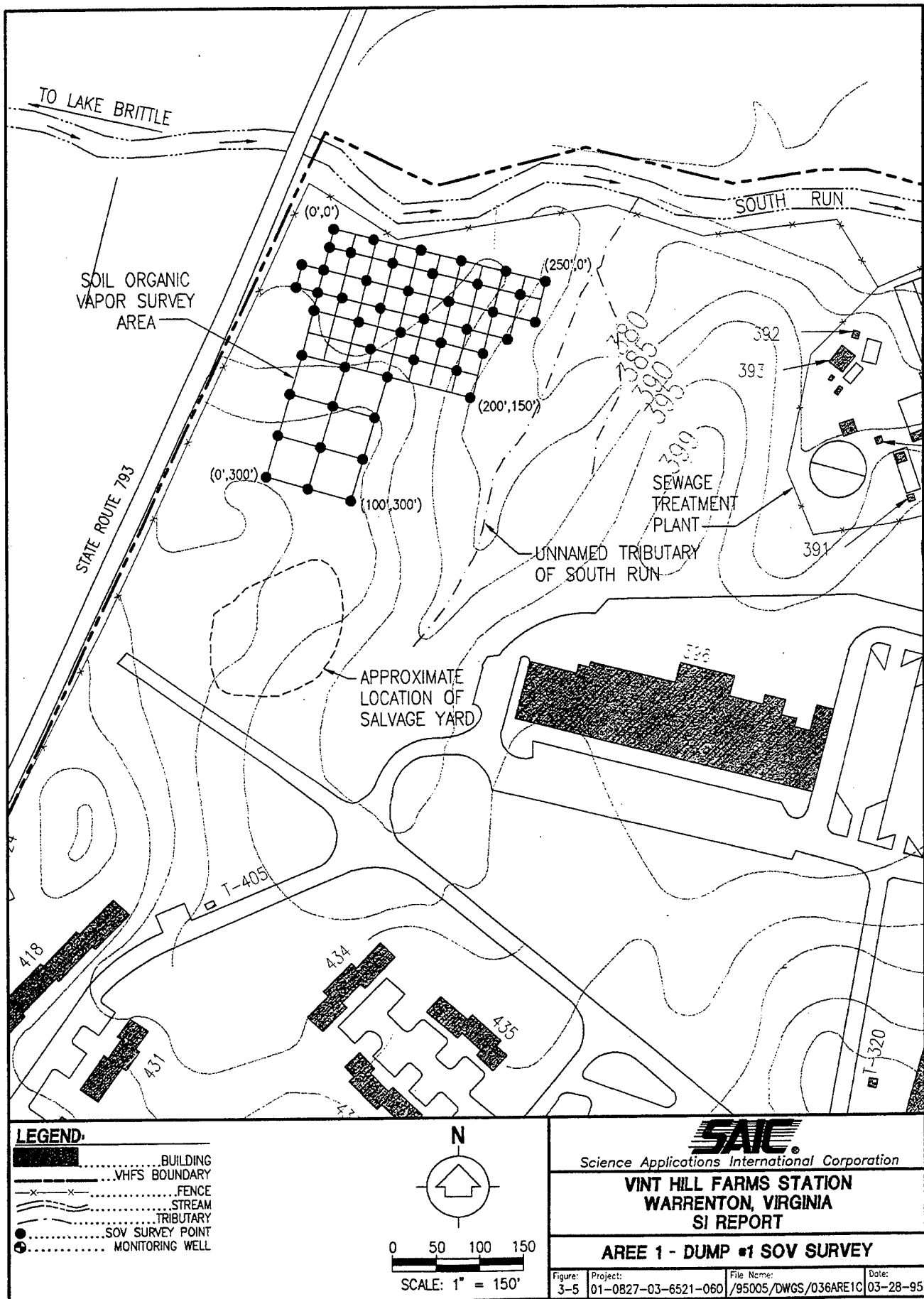
### **3.6.1 AREE 1 - Dump #1**

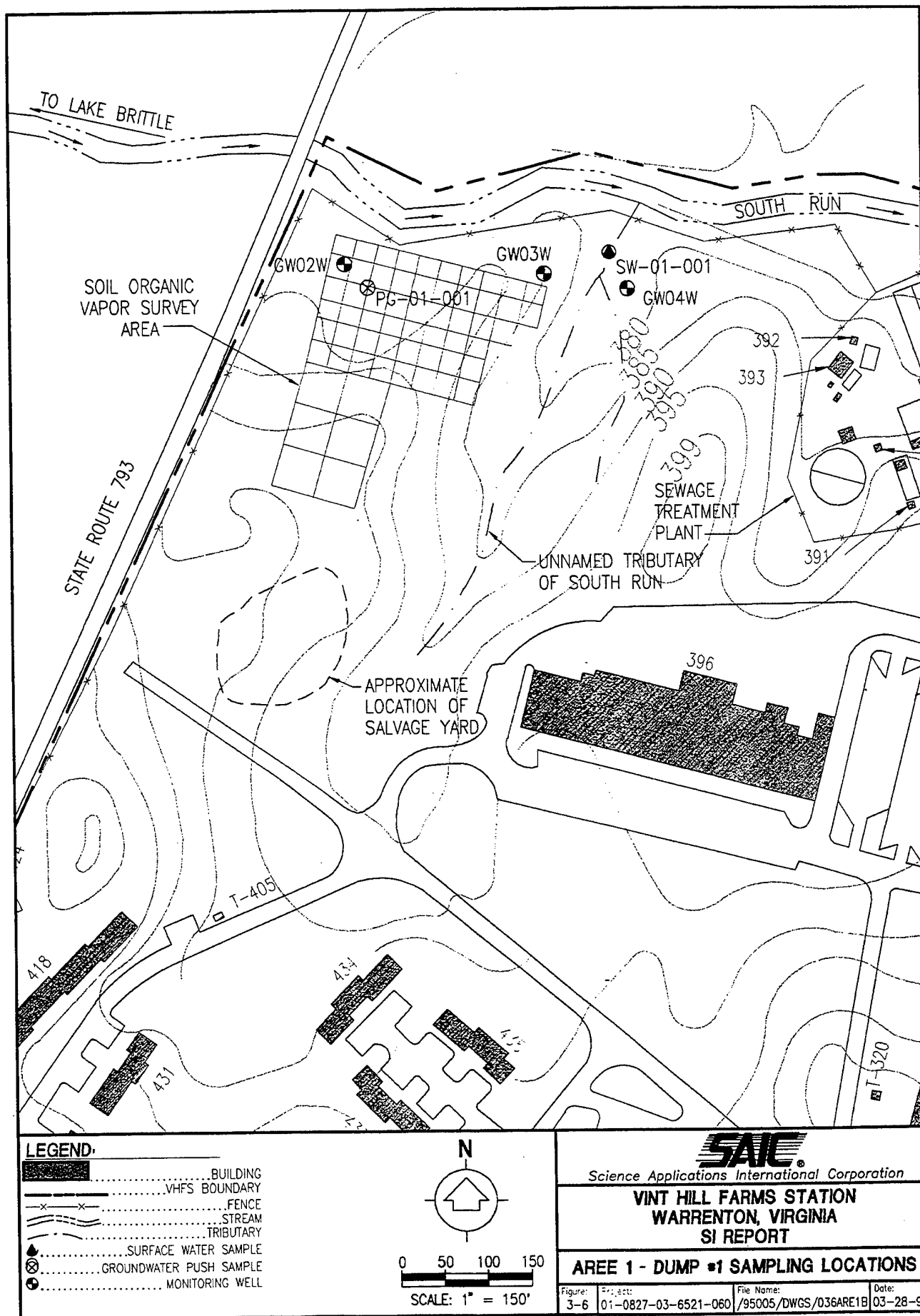
Dump #1 was used for general refuse and installation waste disposal from 1942 to 1973. Operations at the landfill consisted of trench and fill with trenches 6 to 10 feet deep being excavated. Groundwater at Dump #1 is encountered at approximately 10 to 12 feet BLS and flows in a northern direction toward South Run. Sampling at this AREE consisted of a soil organic vapor (SOV) survey with 47 sample points, installation of a groundwater probe in the shallow groundwater, a surface water sample in the adjacent tributary, and groundwater samples from the probe and three existing monitoring wells. Figure 3-5 shows the location of the SOV survey and Figure 3-6 shows the sampling locations at Dump #1. The target compounds at this AREE were VOCs, SVOCs, PCBs, TPH, pesticides, and total metals.

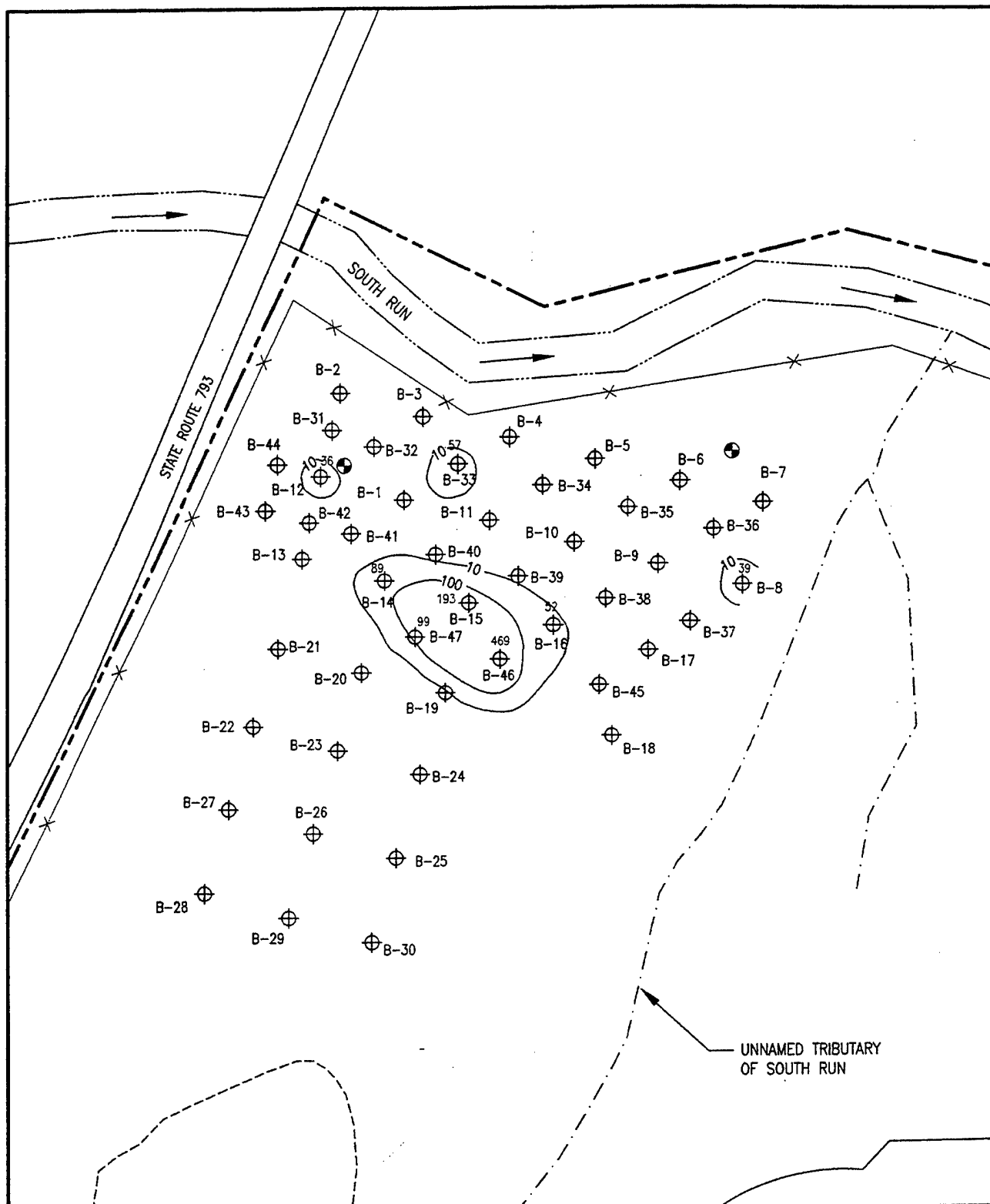
The collection of a landfill leachate sample was attempted during the SI. A sample from the "landfill seep" was collected from the slope leading to the tributary during the 1984 Environmental Contamination Survey (ESE 1986). No seepage was seen on the slope during or after rain events during the SI field sampling program. However, the tributary water was observed to contain floating scum and oil and became heavily sedimented as it passed by the eastern boundary of Dump #1. The area is heavily wooded and vegetated and would reduce the impact of surface runoff. Thus, the contaminants identified in the unnamed South Run tributary surface water sample may be indicative of landfill leachate migrating into the tributary.

#### **3.6.1.1 Soil Organic Vapor Survey Results**

The results of the SOV survey for Dump #1 are provided in Appendix C. The total volatile results are shown in Figure 3-7. (The results for toluene, ethylbenzene, and xylenes are provided in Appendix C.) The SOV survey detected a localized area (B14, B15, B16, B46, B47) of VOCs in the center of Dump #1 at a depth of 5 feet BLS. The maximum concentrations of organic compounds in the soil gas were found at point B-46 with 469  $\mu\text{g/L}$  total volatiles, 14  $\mu\text{g/L}$  toluene, 4.1  $\mu\text{g/L}$  ethylbenzene, and 11  $\mu\text{g/L}$  xylenes. This area measured approximately 110 by 75 feet at its furthest boundaries. Several additional smaller areas (B8, B12, B33) of VOCs also were detected across the northern area of the dump.







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SI REPORT**

**AREE 1 - DUMP #1 TOTAL FID VOLATILES**

The results of the SOV survey were used to determine the location for groundwater probe sampling. A groundwater probe was located downgradient from the localized area of detected organic compounds (i.e., northwest) to determine if the organic compounds had migrated into the shallow groundwater. Point B-40 originally was chosen as the probe location, but this was changed to point B-1 after three unsuccessful attempts to penetrate the near-surface debris at location B-40.

#### 3.6.1.2 Groundwater Sample Results

The results of the laboratory analyses for Dump #1 are provided in Appendix J. Table 3-7 provides the results for those contaminants detected above the CRL. The groundwater probe was located to detect contaminants potentially migrating from the area of VOCs detected in soil vapors at the site downward to shallow groundwater (at approximately 12 feet BLS). The only VOC detected in the groundwater above the CRL was acetone at 800  $\mu\text{g/L}$ . However, according to the data quality assessment, all acetone detections are highly suspect and should be considered as potential false positives. No SVOCs, PCBs, TPH, or pesticides were detected above the CRL in the probe.

Various compounds were detected in three groundwater monitoring wells in and around the dump (GW02W, GW03W, and GW04W), with GW04W containing the highest concentrations of contaminants. As shown in Table 3-7, four metals (arsenic, beryllium, iron, and manganese), two pesticides (chlordane and heptachlor), and one SVOC (bis[2-ethylhexyl]phthalate) were detected above the adjusted tap water RBCs. According to Table 3-8, bis(2-ethylhexyl)phthalate was the only contaminant detected above the drinking water MCL in the groundwater. In addition, two other pesticides (delta-BHC and 4,4'-DDE) were detected at low concentrations. However, delta-BHC was flagged "U," indicating an unconfirmed concentration and, according to the data quality assessment, the result for 4,4'-DDE is considered to have a high bias, since this compound was detected in the associated rinse blank. TPH was detected below the state action level of 1 mg/L in GW02W (760  $\mu\text{g/L}$ ) and GW03W (445  $\mu\text{g/L}$ ). No VOCs were detected above the CRL in the groundwater.



**Table 3-7. Data Summary Table: Groundwater and Surface Water-Dump #1 (AREE 1)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	GW02W	GW02W	GW03W	GW04W
Field Sample Number	SAIC01	SAIC02	SAIC01	SAIC01
Site Type	WELL	WELL	WELL	WELL
Collection Date	11/15/94	11/15/94	11/21/94	11/18/94
Depth (ft)	31.21	31.21	24.13	4.92

<b>METALS/WATER/OF/AAI (AX8, SD18, SD25, T041) (ug/L)</b>				
Laboratory ID Number	UB06291	UB06292	UB06365	UB06358
Parameter	Units	CRL		
Arsenic	ug/L	2.35	LT	2.35**
Lead	ug/L	4.47	LT	4.47**

<b>METALS/WATER/CVAA (CC9) (ug/L)</b>				
Laboratory ID Number	UB06291	UB06292	UB06365	UB06358
Parameter	Units	CRL		
Mercury	ug/L	0.1	LT	0.1**

<b>METALS/WATER/ICP (SS12, 6010) (ug/L)</b>				
Laboratory ID Number	UB06291	UB06292	UB06365	UB06358
Parameter	Units	CRL		
Aluminum	ug/L	112	LT	112**
Barium	ug/L	2.82	14.5**	14.5**
Beryllium	ug/L	1.12	2.36**	2.36**
Calcium	ug/L	105	61300**	61300**
Cobalt	ug/L	25	25**	25**
Chromium	ug/L	16.8	LT	16.8**
Copper	ug/L	18.8	LT	18.8**
Iron	ug/L	77.5	1660**	1660**
Potassium	ug/L	1240	32800**	32800**
Magnesium	ug/L	135	1670**	1670**
Manganese	ug/L	9.67	21.2**	21.2**
Sodium	ug/L	279	19700**	19700**
Nickel	ug/L	32.1	LT	32.1**
Thallium	ug/L	2.44	LT	2.44**
Vanadium	ug/L	27.6	LT	27.6**
Zinc	ug/L	18	LT	18**

<b>VOLATILES/WATER/GCMS (UM21) (ug/L)</b>				
Laboratory ID Number	UB06291	UB06292	UB06365	UB06358
Parameter	Units	CRL		
Acetone	ug/L	8	LT	8**
TICs	ug/L	0	0 (0.0)	0 (0.0)

**Table 3-7. Data Summary Table: Groundwater and Surface Water-Dump #1 (AREE 1)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	GW02W	GW03W	GW03W	GW04W
Field Sample Number	SAIC01	SAIC01	SAIC02	SAIC01
Site Type	WELL	WELL	WELL	WELL
Collection Date	11/15/94	11/21/94	11/21/94	11/18/94
Depth (ft)	31.21	24.13	24.13	4.92

<b>SEMI-VOLATILES/WATER/GCHMS (UM25) (ug/L)</b>			
Laboratory ID Number	UB06291	UB06365	UB06358
Parameter	Units	CRL	
bis(2-Ethylhexyl)phthalate	ug/L	7.7	LT
TICs	ug/L	7.7	0 (0.0)

<b>POLYNUCLEAR AROMATIC HYDROCARBONS/WATER (B310) (ug/L)</b>			
Laboratory ID Number	UB06291	UB06365	UB06358
Parameter	Units	CRL	
Benzo(a)anthracene	ug/L	0.02	LT
Benzo(a)pyrene	ug/L	0.021	LT
Indeno(1,2,3-c,d)pyrene	ug/L	0.02	LT

<b>PESTICIDES/WATER/GCEC (UH20) (ug/L)</b>			
Laboratory ID Number	UB06291	UB06365	UB06358
Parameter	Units	CRL	
Chlordane	ug/L	0.031	LT
delta-BHC	ug/L	0.003	LT
Heptachlor	ug/L	0.003	LT
4,4'-DDE	ug/L	0.004	LT
4,4'-DDT	ug/L	0.003	LT

<b>TRPH/WATER (EPA 418.1) (ug/L)</b>			
Laboratory ID Number	UB06291	UB06365	UB06358
Parameter	Units	CRL	
Total Petroleum Hydrocarbons	ug/L	100	760**

<b>TOTAL LEAD/WATER (SD19) (ug/L)</b>			
Laboratory ID Number	UB06291	UB06365	UB06358
Parameter	Units	CRL	
Total Lead	ug/L	4.47	327** D

**Table 3-7. Data Summary Table: Groundwater and Surface Water-Dump #1 (AREE 1)**  
**Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	PG-01-001	SW-01-001	Residential Tap Water RBCs (EPA 1996)	Adjusted Tap Water RBCs For Groundwater
Field Sample Number	SAIC01	SAIC01		
Site Type	WELL	SPRG		
Collection Date	11/16/94	11/17/94		
Depth (ft)	11.76	0		

<b>METALS/WATER/GFAA (AUX, SD18, SD25, 7041) (ug/L)</b>				
Laboratory ID Number	UB06305			
Parameter	Units	CRL		
Arsenic	ug/L	2.35	4.12**	LT 2.35**
Lead	ug/L	4.47	1100**	LT 4.47**
				0.045c/11n N/A

<b>METALS/WATER/CVAA (CC8) (ug/L)</b>				
Laboratory ID Number	UB06305			
Parameter	Units	CRL		
Mercury	ug/L	0.1	4.6**	LT 0.1**
				11

<b>METALS/WATER/ICP (SS12, 6010) (ug/L)</b>				
Laboratory ID Number	UB06305			
Parameter	Units	CRL		
Aluminum	ug/L	112	1200000**	209**
Barium	ug/L	2.82	11000**	56.6**
Beryllium	ug/L	1.12	130**	1.12**
Calcium	ug/L	105	360000**	23000**
Cobalt	ug/L	25	3400**	25**
Chromium	ug/L	16.8	1800**	16.8**
Copper	ug/L	18.8	3600**	18.8**
Iron	ug/L	77.5	5700000**	26200**
Potassium	ug/L	1240	250000**	1670**
Magnesium	ug/L	135	510000**	7300**
Manganese	ug/L	9.67	150000**	940**
Sodium	ug/L	279	29000**	9070**
Nickel	ug/L	32.1	1500**	32.1**
Thallium	ug/L	2.44	145** JI	2.44**
Vanadium	ug/L	27.6	12000**	27.6**
Zinc	ug/L	18	6200**	18**
				3665
				60

<b>VOLATILES/WATER/OCMS (UM21) (ug/L)</b>				
Laboratory ID Number	UB06305			
Parameter	Units	CRL		
Acetone	ug/L	8	800**	LT 8**
TICs	ug/L		0 (0.0)	0 (0.0)
				3700
				1230

**Table 3-7. Data Summary Table: Groundwater and Surface Water-Dump #1 (AREE 1)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	PG-01-001	SW-01-001	Residential Tap Water RBCs (EPA 1996)	Adjusted Tap Water RBCs For Groundwater
Field Sample Number	SAIC01	SAIC01		
Site Type	WELL	SPRG		
Collection Date	11/16/94	11/17/94		
Depth (ft)	11.76	0		
<b>SEMIVOLATILES/WATER/GCMS (UM25) (ug/L)</b>				
Laboratory ID Number	UB06362	UB06347		
Parameter	Units	CRL		
bis(2-Ethylhexyl)phthalate	ug/L	7.7	LT	7.7**
TICs	ug/L	0 (0.0)		4.8
<b>POLYNUCLEAR AROMATIC HYDROCARBONS/WATER (B310) (ug/L)</b>				
Laboratory ID Number	UB06375	UB06347		
Parameter	Units	CRL		
Benzo(a)anthracene	ug/L	0.02	LT	0.0196**
Benzo(e)pyrene	ug/L	0.021	LT	0.0206**
Indeno(1,2,3-c,d)pyrene	ug/L	0.02	LT	0.0196**
<b>PESTICIDES/WATER/GCEC (UH20) (ug/L)</b>				
Laboratory ID Number	UB06368	UB06347		
Parameter	Units	CRL		
Chlordane	ug/L	0.031	LT	0.0312**
delta-BHC	ug/L	0.003	LT	0.0034**
Heptachlor	ug/L	0.003	LT	0.0025**
4,4'-DDE	ug/L	0.004	LT	0.0039**
4,4'-DDT	ug/L	0.003	LT	0.0029**
<b>TRPHWATER (EPA 418.1) (ug/L)</b>				
Laboratory ID Number	UB06380	UB06347		
Parameter	Units	CRL		
Total Petroleum Hydrocarbons	ug/L	100	LT	100**
<b>TOTAL LEADWATER (SD18) (ug/L)</b>				
Laboratory ID Number	N/A	N/A		
Parameter	Units	CRL		
Total Lead	ug/L	4.47	N/A	N/A

**Footnotes:**

\* - Data collected from chemical transfer file (Phase I).

\*\* - Data collected from USAEC Pyramid system (Phase III).

CRL-Certified reporting limit.

ID-Identification.

N/A-Not applicable.

TICs-Tentatively Identified Compound: number of TICs (total value).

For analytes flagged with "A," "G," "B," "U," or "I," half the detected value was compared with the RBC.

**Flagging Codes:**

U - Analysis is unconfirmed.

Z - Non-target compound analyzed for and detected (non-GC/MS methods).

C - Analysis was confirmed.

D - Duplicate Analysis

I - Interferences in a sample make quantitation and/or identification to be suspect.

J - Value is estimated.

Boolean Codes

LT-Less than the CRL/method detection level.

**Data Qualifiers:**

M - The high spike recovery is high.

G - Analyte found in rinse blank as well as field blank.

**Table 3-8. ARARs Comparison for Groundwater at AREE 1 - Dump #1**  
**Vint Hill Farms Station, Warrenton, Virginia**

Chemical	Proportion exceeding	Maximum Contaminant Level Comparison						Regulatory Source
		Sample ID		Sample Conc. (µg/L)	MCL (µg/L)			
		Site ID	Sample Type				Field Sample	
Diethylhexyl phthalate	2/7	GW03W	WELL	ESE	60.0000 13.0000	6	Final	Federal
		GW03W	WELL	SAIC01				

Chemical	Proportion exceeding	Maximum Contaminant Level Goal Comparison						Federal Status	Regulatory Source
		Sample ID			Sample Conc. (µg/L)	MCLG (µg/L)			
		Site ID	Sample Type	Field Sample					
Diethylhexyl phthalate	2/7	GW03W	WELL	ESE	60.0000	0	Final	Federal	
		GW03W	WELL	SAIC01	13.0000				
Dichloromethane	1/7	GW02W	WELL	ESE	4.0000	0	Final	Federal	
Chlordane	1/7	GW04W	WELL	SAIC01	0.5360	0	Final	Federal	
Lead	1/6	GW03W	WELL	ESE	16.1000*	0	Final	Federal	

\* Dissolved lead

ESE - Samples collected by ESE in August 1984

SAIC01 - Samples collected by SAIC in November 1994

MCL - Maximum Contaminant Level

MCLG - Maximum Contaminant Level Goal

Sources:

Drinking Water Regulations and Health Advisories, EPA, February 1996, Office of Water, Washington, D.C.

Water Quality Criteria - 56 FR 223.58418 (Nov., 1991), "Amendments to the Water Quality Standards Regulation; Compliance with CWA Section 303 (c)(2)(B); Proposed Rule" - Washington D.C.

State Drinking Water Standards - The Bureau of National Affairs, Inc. (BNA), CD-ROMS, August 1994

### **3.6.1.3 Surface Water Sample Results**

The results of the laboratory analyses for Dump #1 are provided in Appendix J. Table 3-7 provides the results for those contaminants detected above the CRL. Two metals (iron and manganese) and one PAH (benzo[a]pyrene) were detected above the adjusted tap water RBCs. As presented in Table 3-9, the concentrations of indeno(1,2,3-c,d)pyrene, manganese, and iron exceeded aquatic health criteria in the surface water. In addition, one PAH (benzo[a]anthracene) and one pesticide (delta-BHC) were detected at low concentrations below protection standards in the surface water. No VOCs, PCBs, TPH, or cyanide were detected above the CRL.

### **3.6.1.4 Site Assessment**

Results from the SOV survey conducted at Dump #1 indicated three small areas of VOC contamination in the northern parts of the dump and a localized area of VOC contamination in the central portion of the dump. A groundwater probe installed downgradient from the identified soil contamination did not confirm the presence of organic compounds in groundwater. However, metals above tap water RBCs and SVOCs, TPH, and pesticides were detected above the CRL in samples collected from the adjacent tributary and existing groundwater monitoring wells. The presence of contamination indicates that the wastes stored within the dump are slowly leaching into the shallow groundwater and migrating to South Run. The concentrations of these contaminants exceeded MCLs and aquatic health criteria for groundwater and surface water, respectively. Based on these results, further activities are recommended for Dump #1 to quantify the soil contamination in the center of the dump (near point B-46), the direction of contaminant migration, and to determine the magnitude and extent of contamination migrating into South Run.

### **3.6.2 AREE 2 - Sewage Treatment Plant**

The Sewage Treatment Plant (STP) treats wastewaters from VHFS activities, including industrial wastewaters from photographic, painting, laboratory, vehicle washing, and metal etching operations. Prior to 1980, the dried sludges from the treatment process were stored on the ground. Sampling at this AREE consisted of collecting two surface soil samples

**Table 3-9. ARARs Comparison for Surface Water at AREE 1 - Dump #1**  
**Vint Hill Farms Station, Warrenton, Virginia**

Chemical	Ambient Water Quality Criteria Comparison for Human Health				
	Proportion Exceeding	Site ID	Sample Type	Field Sample	HH ORG (µg/L)
Indeno (1,2,3,-c,d)pyrene	1/1	SW-01-001	SPRG	SAIC01	0.0480
Manganese	1/1	SW-01-001	SPRG	SAIC01	940
					0.031 (c)
					100 (c)

Chemical	Ambient Water Quality Criteria Comparison for Freshwater				
	Proportion exceeding	Site ID	Sample Type	Field Sample	FW (µg/L)
Iron	1/1	SW-01-001	SPRG	SAIC01	26200
					1000

AWQC - Ambient Water Quality Criteria

ESE - Samples collected by ESE in August 1984

SAIC01 - Samples collected by SAIC in November 1994

HH\_ORG - Human Health for Consumption of Organisms Only

FW - Freshwater Criterion Continuous

SPRG - Spring sample

c - criteria designated as organoleptic are based on taste and odor effects, not human health effects. Health-based WQC are not available for these chemicals

**Sources:**

Drinking Water Regulations and Health Advisories, EPA, February 1996, Office of Water, Washington, D.C.

Water Quality Criteria - 56 FR 223.58418 (Nov., 1991), "Amendments to the Water Quality Standards Regulation; Compliance with

CWA Section 303 (c)(2)(B); Proposed Rule" - Washington D.C.

State Drinking Water Standards - The Bureau of National Affairs, Inc. (BNA), CD-ROMS, August 1994

downgradient from the former sludge pile location. Figure 3-8 shows the locations of the surface soil samples at the STP. The target compounds at this AREE were SVOCs, cyanide, and total metals.

#### **3.6.2.1 Surface Soil Sample Results**

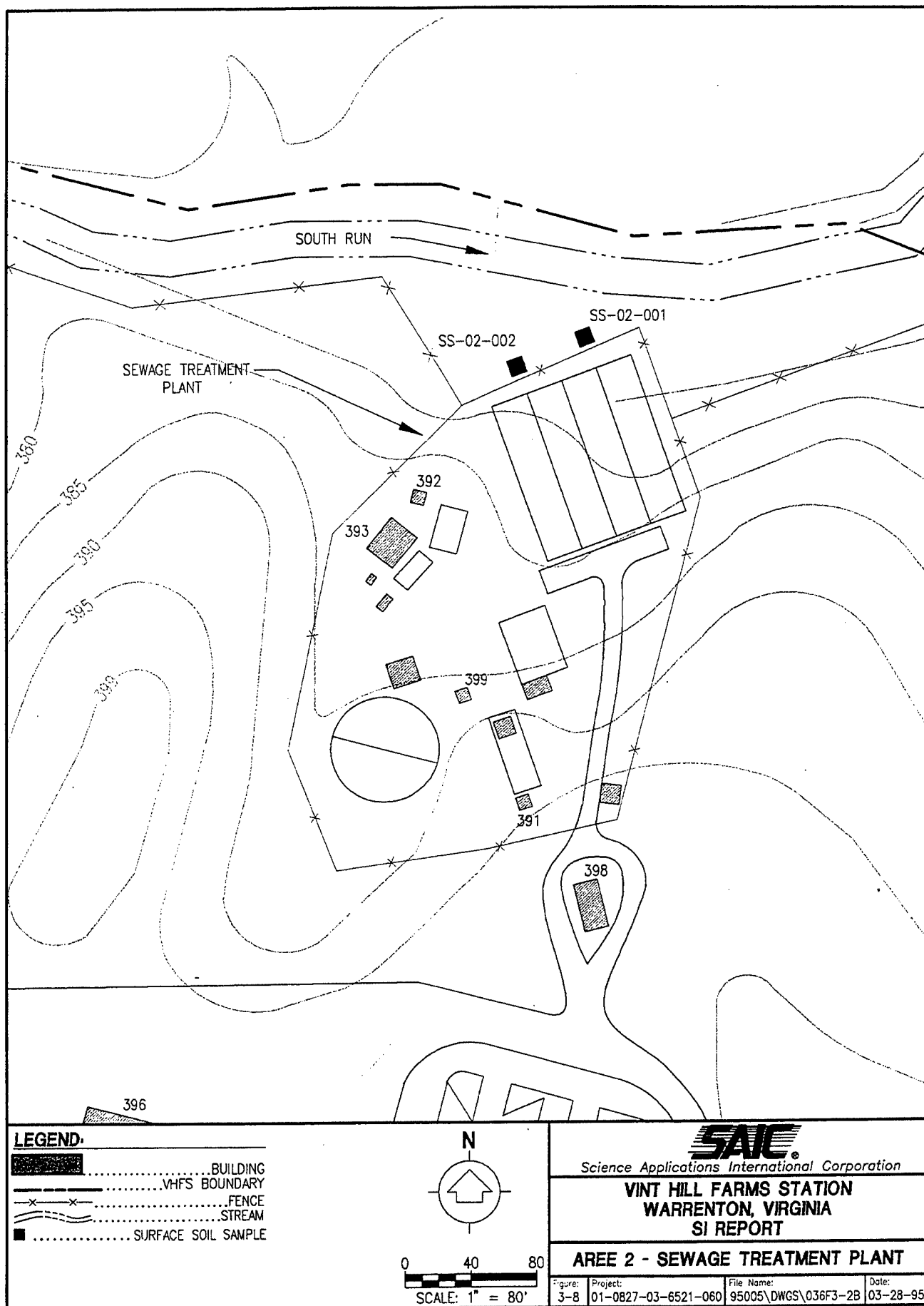
The results of the laboratory analyses for the STP are provided in Appendix J. Table 3-10 provides the results and industrial soil RBCs for those contaminants that were detected above the CRL. Two metals (arsenic and beryllium) were detected above the industrial soil RBCs. (Industrial soil RBCs were used instead of residential soil RBCs because the future land use for this AREE will continue as an STP.) Fluoranthene also was detected in both soil samples at a maximum concentration of 78  $\mu\text{g/g}$ , which is well below the industrial soil RBC of 82,000  $\mu\text{g/g}$ . Cyanide was not detected above the CRL.

As shown in Table 3-11, the concentrations of beryllium (1.04 and 1.48  $\mu\text{g/g}$ ) were less than the UTL of 5.10  $\mu\text{g/g}$ , whereas the concentrations of arsenic (3.99 and 5.84  $\mu\text{g/g}$ ) exceeded background because arsenic was not detected in the background samples. However, according to Table 3-5, the concentrations of arsenic are within two standard deviations of the regional average for arsenic (4.8  $\mu\text{g/g}$ ).

#### **3.6.2.2 Streamlined Risk Assessment**

A streamlined risk assessment was conducted for current and future land uses at AREE 2. Risks were calculated only for the soil ingestion pathway. As shown in Table 3-12, noncancer HIs were below 1 and cancer risks were below  $1 \times 10^{-4}$  for both the station and construction workers. Under a residential land use scenario, the noncancer HI exceeded 1 for the child; the cancer risks, however, did not exceed  $1 \times 10^{-4}$  for either residential receptor. The chemicals responsible for the child HI in excess of the target are manganese and vanadium.





**Table 3-10. Data Summary Table: Soil - Sewage Treatment Plant (AREE 2)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SS-02-001	SS-02-002	Industrial RBCs
Field Sample Number	SAIC01	SAIC01	(EPA 1996)
Site Type	SURF	SURF	
Collection Date	11/14/94	11/14/94	
Depth (ft)	0	0	
<b>METALS/SOIL/CAA (Y9) (ug/g)</b>			
Laboratory ID Number	UB06280	UB06281	
Parameter	Units	CRL	
Mercury	ug/g	0.05	1.27** 4.3** 610
<b>METALS/SOIL/GFAA (B9, JD20, JD21) (ug/g)</b>			
Laboratory ID Number	UB06280	UB06281	
Parameter	Units	CRL	
Arsenic	ug/g	2.5	5.84** 3.99** 3.8c/610n
Lead	ug/g	0.467	26.8** 52** N/A
<b>METALS/SOIL/ICP (J512) (ug/g)</b>			
Laboratory ID Number	UB06280	UB06281	
Parameter	Units	CRL	
Aluminum	ug/g	11.2	50700** 48800** 1,000,000
Barium	ug/g	3.29	259** 199** 140,000
Beryllium	ug/g	0.427	1.04** 1.48** 1.3c/10220n
Calcium	ug/g	25.3	9450** 3440** N/A
Cobalt	ug/g	2.5	44.6** 40.8** 120,000
Chromium	ug/g	1.04	41.1** 40.3** 10,000
Copper	ug/g	2.84	75.8** 65.8** 82,000
Iron	ug/g	6.66	77600** 82000** 610,000
Potassium	ug/g	131	986** 895** N/A
Magnesium	ug/g	10.1	3730** 2670** N/A
Manganese	ug/g	9.87	1600** 1390** 286,000
Silver	ug/g	0.803	4.07** 0.803** 10,000
Sodium	ug/g	38.7	220** 181** N/A
Nickel	ug/g	2.74	22.6** 22.4** 41,000
Vanadium	ug/g	1.14	213** 223** 14,000
Zinc	ug/g	2.34	271** 180** 610,000

Table 3-10. Data Summary Table: Soil - Sewage Treatment Plant (AREE 2)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)

Site ID	SS-02-001	SS-02-002	Industrial RBCs
Field Sample Number	SAIC01	SAIC01	SAIC01
Site Type	SURF	SURF	(EPA 1996)
Collection Date	11/14/94	11/14/94	
Depth (ft)	0	0	

SEMI-VOLATILES/SOIL/GCMS (LM25) (ug/g)			
Laboratory ID Number	Units	CRL	
UB06280	ug/g	0.032	
Fluoranthene	ug/g	0.074**	82,000
TiCs		11 (18.5)	N/A
UB06281		0.078**	
		12 (11.6)	

Footnotes:  
 \* - Data collected from chemical transfer file (Phase I)  
 \*\* - Data collected from USAEC Pyramid system (Phase III)  
 CRL - Certified reporting limit  
 ID - Identification  
 N/A - Not applicable  
 QC - Quality control  
 TiCs - Tentatively Identified Compound: number of TiCs (total value)  
 c - Carcinogenic effects.  
 n - Noncarcinogenic effects.  
 Boolean Codes  
 LT - Less than the certified reporting limit / method detection level

**Table 3-11. Background Soil Comparison-Sewage Treatment Plant (AREE 2)  
Vint Hill Farms Station, Warrenton, Virginia**

Substance	AREE 2 SOIL					Differs from Background?
	P,t,s	P,t,p	P,m-w	UTL (ppm)	% > UTL	Upper Tail (UTL test)
Aluminum	-	-	-	-	-	-
Arsenic	-	-	-	-	-	yes; NDB
Barium	-	-	-	-	-	-
Beryllium	-	-	-	5.10	0%	no
Cadmium	-	-	-	-	-	-
Calcium	-	-	-	-	-	-
Chromium	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-
Copper	-	-	-	-	-	-
Iron	-	-	-	-	-	-
Lead	-	-	-	-	-	-
Magnesium	-	-	-	-	-	-
Manganese	-	-	-	-	-	-
Mercury	-	-	-	-	-	-
Nickel	-	-	-	-	-	-
Potassium	-	-	-	-	-	-
Selenium	-	-	-	-	-	-
Silver	-	-	-	-	-	-
Sodium	-	-	-	-	-	-
Thallium	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-
Zinc	-	-	-	-	-	-

**Notes:**

P,t,s - t-test type I error probability assuming separate (or unequal) variances

P,t,p - t-test type I error probability assuming pooled (or equal) variances

P,m-w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples

**Table 3-12. Risk Characterization Summary for  
Soil Ingestion at the Sewage Treatment Plant (AREE 2)**

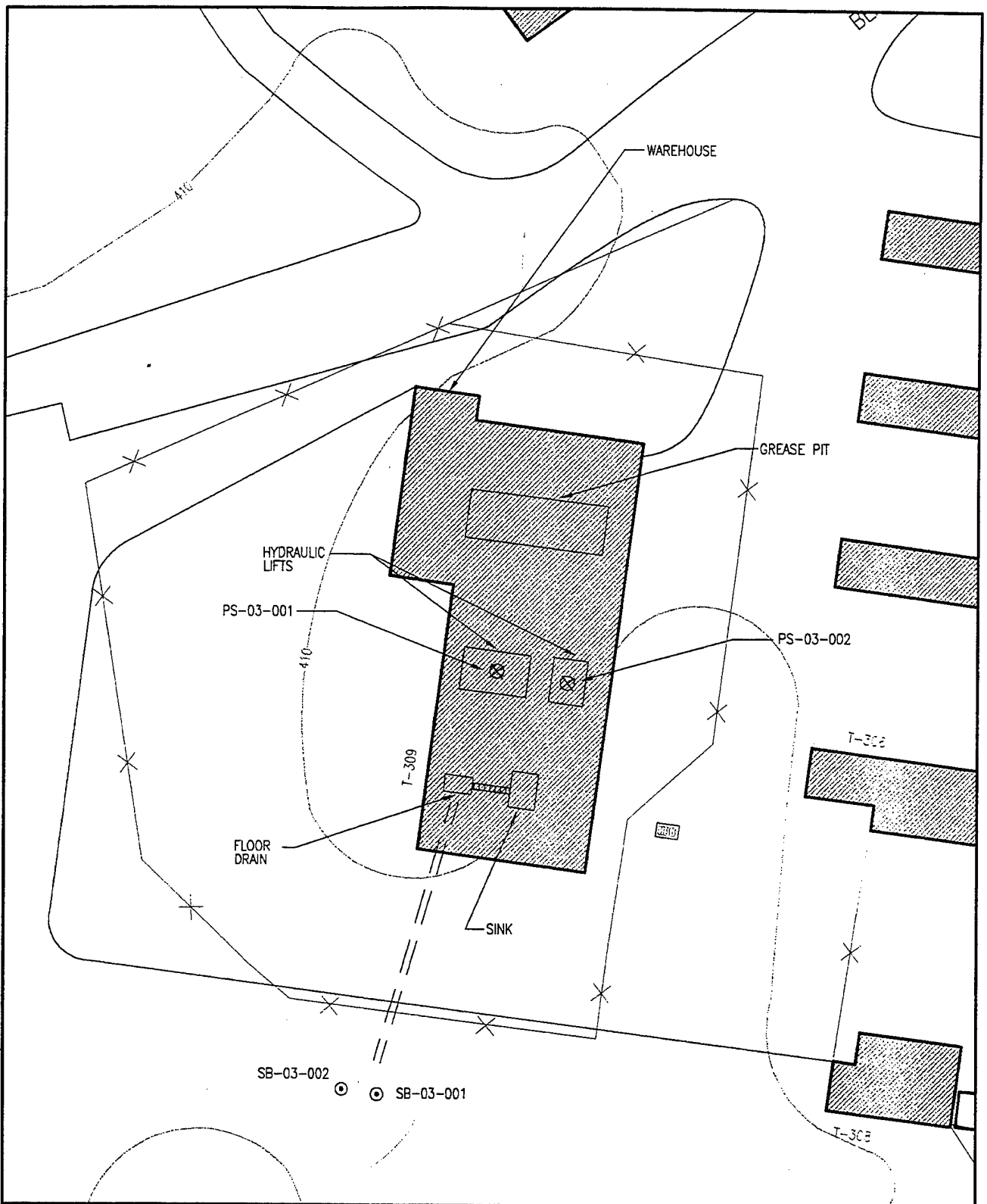
Current Land Use				Future Land Use			
Noncancer HI		Cancer Risk		Noncancer HI		Cancer Risk	
Station Worker	Construction Worker	Station Worker	Construction Worker	Resident Child	Resident Adult	Resident Child	Resident Adult
0.1	0.7	5E-06	3E-06	2	0.2	2E-05	9E-06

### 3.6.2.3 Site Assessment

Two surface soil borings were located directly downgradient from the former sludge pile location to determine the maximum concentrations of contaminants. Chemical analyses of the soils did not detect metals or organic compounds at concentrations greater than the industrial soil RBCs except for beryllium and arsenic, which are within background and regional ranges, respectively. According to the streamlined risk assessment, risks do not exceed EPA target levels under the current (industrial) land use. Therefore, because the most likely future land use also is industrial, no further activities are recommended for the STP. However, EPA has requested additional sampling to further characterize the AREE.

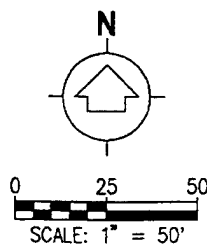
### 3.6.3 AREE 3 - Warehouse

The Warehouse was used as a vehicle maintenance area from 1943 to 1967. Two sets of concrete-filled pits, which formerly were used for the hydraulic lifts and grease pit, exist on the Warehouse floor. The overflow from the floor drain discharges to the field south of the Warehouse. Sampling at AREE 3 consisted of drilling two soil borings at the approximate location of the floor drain discharge and one push boring within each of the hydraulic lifts. One soil sample was collected from each soil boring at the estimated level of floor drain discharge (i.e., 2 to 4 feet BLS) and one soil sample was collected from each hydraulic lift at the interval below the lift bottom (i.e., 2 to 4 feet BLS). Figure 3-9 shows the locations of the soil and push borings at the Warehouse. The target compounds at this AREE were VOCs, SVOCs, and total metals at the floor drain outlet and VOCs, TPH, and total metals at the hydraulic lift location.



**LEGEND:**

- X-X- FENCE
- [Hatched Box] BUILDING
- == ROAD
- SOIL BORING
- ⊗ SOIL PUSH SAMPLE



**SAIC**

Science Applications International Corporation

**VINT HILL FARMS STATION  
WARRENTON, VIRGINIA  
SI REPORT**

**AREE 3 - WAREHOUSE**

Figure: 3-9	Project: 01-0827-03-6521-060	File Name: /95005/DWGS/036ARE4B	Date: 03-28-95
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### 3.6.3.1 Soil Boring and Push Boring Results

The results of the laboratory analyses for the Warehouse are provided in Appendix J. Table 3-13 provides the results and residential soil RBCs for those contaminants that were detected above the CRL. Six metals (aluminum, beryllium, chromium, iron, manganese, and vanadium) were detected above their adjusted residential soil RBCs in the soils sampled from underneath the hydraulic lifts. TPH also was detected in the soil samples from underneath the hydraulic lifts at a maximum concentration of 40.5  $\mu\text{g/g}$ . No VOCs were detected above the CRL underneath the hydraulic lifts.

As shown in Table 3-13, five metals (aluminum, arsenic, beryllium, iron, and vanadium) and one SVOC (benzo[b]fluoranthene) were detected above their adjusted residential soil RBCs at the drain outlet. In addition, eight other SVOCs were detected in the soils at the drain outlet, including benzo(a)anthracene and pyrene. No VOCs were detected above the CRL at the drain outlet.

As shown in Table 3-14, the concentrations of vanadium, iron, and beryllium are below background concentrations according to the UTL and t-test, whereas the concentrations of aluminum, chromium, and manganese exceeded background concentrations according to the UTL test. In addition, the concentrations of arsenic exceed background because this metal was not detected in the background samples. According to Table 3-5, the maximum detected concentration of arsenic (5.46  $\mu\text{g/g}$ ) is within two standard deviations of the regional average for arsenic (4.8  $\mu\text{g/g}$ ).

### 3.6.3.2 Site Assessment

Concentrations of metals and TPH that are indicative of waste oil contamination were detected in soil samples collected beneath the hydraulic lifts. SVOCs typical of cleaning fluids were detected in soil samples from the drain outlet. Four compounds (aluminum, chromium, manganese, and benzo[b]fluoranthene) were detected at concentrations greater than the residential soil RBCs and above background ranges. Based on these results, additional investigation activities are warranted at both the hydraulic lifts and the drain outlet to determine the full extent of contamination in the soils. In addition, since the hydraulic lifts had leaked, it is likely that

**Table 3-13. Data Summary Table: Soil - Warehouse (AREE 3)  
Vint Hill Farms Station, Warrenton, Virginia**

Site ID	PS-03-001	PS-03-002	SB-03-001	SB-03-002	Residential RBCs (EPA 1996)	Adjusted RBCs
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01		
Site Type	BORE	BORE	BORE	BORE		
Collection Date	11/14/94	11/14/94	11/1/94	11/1/94		
Depth (ft)	2	2	2	2		

<b>METALS/SOIL/GFAA (B9, JD20, JD21) (ug/g)</b>					
Laboratory ID Number	UB06286	UB06287	UB06101	UB06102	
Parameter	Units	CRL	Units	CRL	
Arsenic	ug/g	2.5	LT	2.5**	LT
Lead	ug/g	0.467	9.38**	10.5**	13.3**
					0.43c/23n
					N/A
					3.8n

<b>METALS/SOIL/ICP (JS12) (ug/g)</b>					
Laboratory ID Number	UB06286	UB06287	UB06101	UB06102	
Parameter	Units	CRL	Units	CRL	
Aluminum	ug/g	11.2	67800**	55500**	78000
Barium	ug/g	3.29	282**	169**	5500
Beryllium	ug/g	0.427	1.09**	2.19**	2
Calcium	ug/g	25.3	45700**	2470**	0.15c/390n
Cobalt	ug/g	2.5	64.2**	51.3**	N/A
Chromium	ug/g	1.04	68.1**	32.5**	4700
Copper	ug/g	2.84	62.6**	47.7**	390
Iron	ug/g	6.66	97000**	160000**	3100
Potassium	ug/g	131	638**	501**	23000
Magnesium	ug/g	10.1	20600**	2610**	N/A
Manganese	ug/g	9.87	2600**	687**	N/A
Sodium	ug/g	38.7	340**	90.1**	10950
Nickel	ug/g	2.74	42.1**	21.9**	N/A
Vanadium	ug/g	1.14	239**	374**	1600
Zinc	ug/g	2.34	130**	64.2**	550
					23000
					3830
					1825
					92

<b>SEMI-VOLATILES/SOIL/GCMS (LM25) (ug/g)</b>					
Laboratory ID Number	N/A	N/A	UB06101	UB06102	
Parameter	Units	CRL	Units	CRL	
Acenaphthylene	ug/g	0.033	N/A	N/A	N/A
Benzo(a)anthracene	ug/g	0.041	N/A	N/A	0.88
Benzo(b)fluoranthene	ug/g	0.31	N/A	N/A	0.88
Benzo(g,h,i)perylene	ug/g	0.16	N/A	N/A	N/A
Benzo(k)fluoranthene	ug/g	0.13	N/A	N/A	8.8
Chrysene	ug/g	0.032	N/A	N/A	88
Fluoranthene	ug/g	0.032	N/A	N/A	0.066**
					3100



**Table 3-13. Data Summary Table: Soil - Warehouse (AREE 3)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	PS-03-001	PS-03-002	SB-03-001	SB-03-002	Adjusted RBCs
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01	Residential RBCs
Site Type	BORE	BORE	BORE	BORE	(EPA 1996)
Collection Date	11/14/94	11/14/94	11/1/94	11/1/94	
Depth (ft)	2	2	2	2	
<hr/>					
Phenanthrene					
Pyrene	ug/g 0.032	N/A	LT 0.032**	0.64**	2300***
TICs	ug/g 0.083	N/A	LT 0.083**	1.2**	2300
		N/A	7 (5.0)	17 (15.3)	N/A
<hr/>					
<b>TPH/Soil (EPA 418.1) (ug/g)</b>					
Laboratory ID Number	UB06285	UB06286	N/A	N/A	
Parameter	Units CRL				
Total Petroleum Hydrocarbons	ug/g 10	25.9**	N/A	N/A	N/A

**Footnotes:**

- \* - Data collected from chemical transfer file (Phase I)
- \*\* - Data collected from USAEC Pyramid system (Phase III)
- \*\*\* - RBC for pyrene, a chemically-similar compound
- CRL - Certified reporting limit
- ID - Identification
- N/A - Not applicable
- QC - Quality control
- TICs - Tentatively Identified Compound: number of TICs (total value)
- G - Carcinogenic effects
- N - Noncarcinogenic effects
- Boolean Codes
- LT - Less than the certified reporting limit / method detection level

**Table 3-14. Background Soil Comparison-Warehouse (AREE 3)  
Vint Hill Farms Station, Warrenton, Virginia**

Substance	AREE 3 SOIL					Differs from Background?	
	P,t,s	P,t,p	P,m-w	UTL (ppm)	% > UTL	Central	Upper Tail
						Tendency (t-test, MW test)	(UTL test)
Aluminum	0.111	0.071		60600.00	50%	no	yes
Arsenic	-	-	-	-	-	yes; NDB	yes; NDB
Barium	-	-	-	-	-	-	-
Beryllium	0.393	0.365		5.10	0%	no	no
Cadmium	-	-	-	-	-	-	-
Calcium	-	-	-	-	-	-	-
Chromium	-	-	0.773	75.60	25%	no	yes
Cobalt	-	-	-	-	-	-	-
Copper	-	-	-	-	-	-	-
Iron	-	-	0.386	180000.00	0%	no	no
Lead	-	-	-	-	-	-	-
Magnesium	-	-	-	-	-	-	-
Manganese	0.012	0.012	-	441.00	100%	yes	yes
Mercury	-	-	-	-	-	-	-
Nickel	-	-	-	-	-	-	-
Potassium	-	-	-	-	-	-	-
Selenium	-	-	-	-	-	-	-
Silver	-	-	-	-	-	-	-
Sodium	-	-	-	-	-	-	-
Thallium	-	-	-	-	-	-	-
Vanadium	0.421	0.395		531.00	0%	no	no
Zinc	-	-	-	-	-	-	-

**Notes:**

P,t,s - t-test type I error probability assuming separate (or unequal) variances

P,t,p - t-test type I error probability assuming pooled (or equal) variances

P,m-w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples

the grease pits also may have leaked. Measures should be taken to confirm the presence or absence of contamination at the grease pit location.

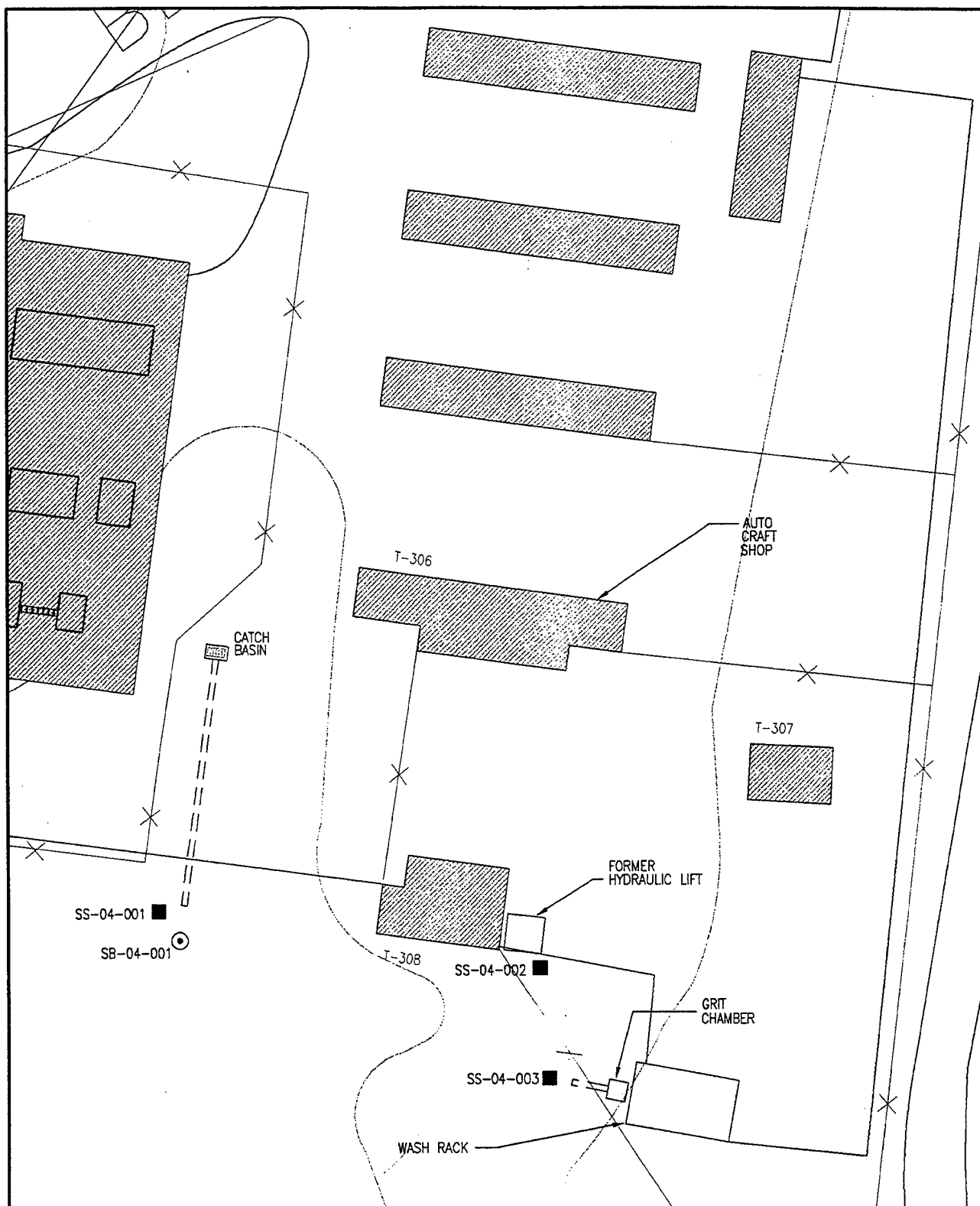
#### **3.6.4 AREE 4 - Auto Craft Shop**

The Auto Craft Shop was used to perform various vehicle maintenance activities from 1968 to 1994. The buildings were used to store oil, solvents, and lubricants for these activities. Sampling at this AREE consisted of sampling three surface soil borings and one shallow soil boring drilled to 4 feet BLS. Soil sampling locations were placed in areas where the surface runoff from the Auto Craft Shop discharges to the surrounding soils. Figure 3-10 shows the location of the surface soil borings and shallow soil boring at the Auto Craft Shop. The target compounds at this AREE were VOCs, SVOCs, TPH, and total metals.

##### **3.6.4.1 Soil Boring Results**

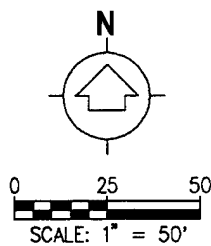
The results of the laboratory analyses for the Auto Craft Shop are provided in Appendix J. Table 3-15 provides the results and residential soil RBCs for those contaminants detected above the CRL. Five metals (aluminum, arsenic, beryllium, iron, and vanadium) and two SVOCs (benzo[a]anthracene and benzo[b]fluoranthene) were detected above their adjusted residential soil RBCs. Lead was detected above the EPA screening level for lead in residential soils of 400 ppm. In addition, 10 other SVOCs were detected at low concentrations, including pyrene and bis(2-ethylhexyl)phthalate. TPH was detected in all surface soil samples above the state action level of 100 ppm and had a maximum concentration of 1,860  $\mu\text{g/g}$  at SS-04-002. No VOCs were detected above the CRL in any of the samples.

As shown in Table 3-16, the concentrations of aluminum, beryllium, iron, and vanadium are below background concentrations according to the UTL and t-test, whereas the concentrations of lead exceeded background according to the UTL test. In addition, the concentrations of arsenic exceeded background because this metal was not detected in the background samples. The maximum detected concentration of arsenic (10.3  $\mu\text{g/g}$ ) is more than two standard deviations above the regional average for arsenic and is, therefore, considered present at a non-naturally occurring concentration (see Table 3-5).



# **LEGEND**

- x-x- FENCE
- [Hatched Box] BUILDING
- == ROAD
- STORM DRAIN
- ⊙ SOIL BORING
- SURFACE SOIL SAMPLE



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**AREE 4 - AUTO CRAFT SHOP**

Figure: 3-10	Project: 01-0827-03-6521-060	File Name: /95005/DWGS/036ARE4C	Date: 03-28-95
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**Table 3-15. Data Summary Table: Soil - Auto Craft Shop (AREE 4)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SB-04-001	SS-04-001	SS-04-001	SS-04-001	SS-04-002	SS-04-003	Residential RBCs (EPA 1996)	Adjusted RBCs
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC02	SAIC01	SAIC01		
Site Type	BORE	SURF	SURF	SURF	SURF	SURF		
Collection Date	10/31/94	11/2/94	11/2/94	11/2/94	11/2/94	11/3/94		
Depth (ft)	2	0	0	0	0	0		

<b>METALS/SOIL/CVAA (Y9) (ug/g)</b>									
Laboratory ID Number	UB06077	UB06114	UB06116	UB06139					
Parameter									
Mercury	Units ug/g	CRL 0.05	LT 0.05**	0.327** D	LT 0.05**	0.163**	23		

<b>METALS/SOIL/GFAA (E9, J020, J021) (ug/g)</b>									
Laboratory ID Number	UB06077	UB06114	UB06115	UB06116	UB06139				
Parameter									
Arsenic	Units ug/g	2.5**	7.99** D	10.3**	2.5**	0.432/23n			4.6n
Lead	ug/g	19.2**	1700** D	1000**	420**	N/A			

<b>METALS/SOIL/ICP (J012) (ug/g)</b>									
Laboratory ID Number	UB06077	UB06114	UB06115	UB06116	UB06139				
Parameter									
Aluminum	Units ug/g	11.2	17100** D	15800**	17200**	78000			15600
Barium	ug/g	3.29	223** D	175**	110**	5500			
Beryllium	ug/g	0.427	0.427** D	0.427**	0.427**	0.152/390n			
Calcium	ug/g	25.3	1960**	5660**	3600**	N/A			
Cadmium	ug/g	1.2	1.2**	5.17** D	4.18**	78			
Cobalt	ug/g	2.5	28.5**	18.1** D	7.39**	4700			
Chromium	ug/g	1.04	32.5**	68.1** D	30.5**	390			78
Copper	ug/g	2.84	57.4**	123** D	68.7**	3100			
Iron	ug/g	6.66	140000**	42700** D	24300**	23000			4600
Potassium	ug/g	131	385**	549** D	512**	N/A			
Magnesium	ug/g	10.1	3370**	4180** D	1700**	N/A			
Manganese	ug/g	9.87	111**	2600**	70.9**	10950			
Sodium	ug/g	38.7	1600**	987** D	331**	N/A			
Nickel	ug/g	2.74	18.5**	24.6** D	13.9**	1600			110
Vanadium	ug/g	1.14	101**	85** D	69.5**	550			
Zinc	ug/g	2.34	78.1**	542** D	298**	23000			

<b>VOLATILES/SOIL/GCMS (LM23) (ug/g)</b>									
Laboratory ID Number	UB06077	UB06114	UB06115	UB06116	UB06139				
Parameter									
TICs	Units ug/g	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (3.7)			N/A

**Table 3-15. Data Summary Table: Soil - Auto Craft Shop (AREE 4)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	SB-04-001	SS-04-001	SS-04-001	SS-04-002	SS-04-003	Residential RBCs (EPA 1996)	Adjusted RBCs
Field Sample Number	SAIC01	SAIC01	SAIC02	SAIC01	SAIC01		
Site Type	BORE	SURF	SURF	SURF	SURF		
Collection Date	10/31/94	11/2/94	11/2/94	11/2/94	11/3/94		
Depth (ft)	2	0	0	0	0		

<b>SEMI-VOLATILES/SOIL/GCMS (LM25) (ug/g)</b>									
Laboratory ID Number	UB06077	UB06114	UB06115	UB06116	UB06139				
Parameter	Units	CRL	Units	CRL	Units	CRL			
2-Methylnaphthalene	ug/g	0.032	LT	0.032**	LT	0.07**			
Acenaphthylene	ug/g	0.033	LT	0.033**	LT	0.07**			N/A
bis(2-Ethylhexyl)phthalate	ug/g	0.48	1**	2** D	2** D	1**			46
Benzo(a)anthracene	ug/g	0.041	1**	2** D	2** D	0.08**			0.88
Benzo(b)fluoranthene	ug/g	0.31	LT	0.31**	LT	0.28**			0.88
Benzo(g,h,i)perylene	ug/g	0.18	LT	0.18**	LT	0.31**			N/A
Benzo(k)fluoranthene	ug/g	0.13	LT	0.34**	LT	1.2**			8.8
Chrysene	ug/g	0.032	1**	1** D	1** D	0.47**			88
di-N-Butyl Phthalate	ug/g	1.3	2**	2** D	2** D	0.06**			7800
Fluoranthene	ug/g	0.032	3**	3** D	3** D	1.3**			3100
Phenanthrene	ug/g	0.032	2**	2** D	2** D	0.35**			2300***
Pyrene	ug/g	0.083	4**	1** D	1** D	0.43**			2300
TICs	ug/g		8 (26.1)	3** D	3** D	0.73**			N/A
				9 (8.9)	8 (7.5)	82 (102.9)			

<b>TPH/SOIL (EPA 418.1) (ug/g)</b>									
Laboratory ID Number	UB06077	UB06114	UB06115	UB06116	UB06139				
Parameter	Units	CRL	Units	CRL	Units	CRL			
Total Petroleum Hydrocarbons	ug/g	10	58.4**	1310**	1630** D	1860**			N/A

Footnotes:  
 \* - Data collected from chemical transfer file (Phase I)  
 \*\* - Data collected from USAEC Pyramid system (Phase III)  
 \*\*\* - RBC for pyrene, a chemically-similar compound  
 CRL - Certified reporting limit  
 ID - Identification  
 QC - Quality control  
 N/A - Not applicable  
 TICs - Tentatively Identified Compound: number of TICs (total value)  
 c - Carcinogenic effects  
 n - Noncarcinogenic effects  
 Boolean Codes  
 LT - Less than the certified reporting limit / method detection level  
 Flagging Codes  
 D - Duplicate analysis.

**Table 3-16. Background Soil Comparison-Auto Craft Shop (AREE 4)  
Vint Hill Farms Station, Warrenton, Virginia**

Substance	AREE 4 SOIL					Differs from Background?	
	P,t,s	P,t,p	P,m-w	UTL (ppm)	% > UTL	Central Tendency	
						(t-test, MW test)	Upper Tail (UTL test)
Aluminum	0.175	0.168		60600.00	0%	no	no
Arsenic	-	-	-	-	-	yes; NDB	yes; NDB
Barium	-	-	-	-	-	-	-
Beryllium	0.256	0.247		5.10	0%	no	no
Cadmium	-	-	-	-	-	-	-
Calcium	-	-	-	-	-	-	-
Chromium	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-
Copper	-	-	-	-	-	-	-
Iron	0.169	0.164	-	180000.00	0%	no	no
Lead	0.219	0.172		13.00	100%	no	yes
Magnesium	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-
Mercury	-	-	-	-	-	-	-
Nickel	-	-	-	-	-	-	-
Potassium	-	-	-	-	-	-	-
Selenium	-	-	-	-	-	-	-
Silver	-	-	-	-	-	-	-
Sodium	-	-	-	-	-	-	-
Thallium	-	-	-	-	-	-	-
Vanadium	0.277	0.276		531.00	0%	no	no
Zinc	-	-	-	-	-	-	-

**Notes:**

P,t,s - t-test type I error probability assuming separate (or unequal) variances

P,t,p - t-test type I error probability assuming pooled (or equal) variances

P,m-w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples

#### **3.6.4.2 Site Assessment**

Metals and PAHs were detected above residential soil RBCs and TPH and lead were detected above action levels in samples collected from the four soil borings. The concentrations of metals, SVOCs, and TPH detected at the Auto Craft Shop are indicative of contamination from previous car maintenance activities. Based on these results, further activities are recommended for the Auto Craft Shop to characterize the horizontal and vertical extent of contamination at each of the three runoff points.

#### **3.6.5 AREE 5 - EPIC Building**

The Environmental Photographic Interpretation Center (EPIC) Building discharged photographic wastewaters to the Former Photographic Wastewater Lagoon (AREE 10) through a 6-inch vitrified clay pipe from 1958 to 1983. Sampling at this AREE consisted of a sewerline video survey, drilling and sampling six soil borings, and sampling an existing groundwater monitoring well located adjacent to the sewerline. Figures 3-11 and 3-12 show the locations of the soil borings and monitoring well along the EPIC Building sewerline. The target compounds at this AREE were VOCs, SVOCs, cyanide, and total metals.

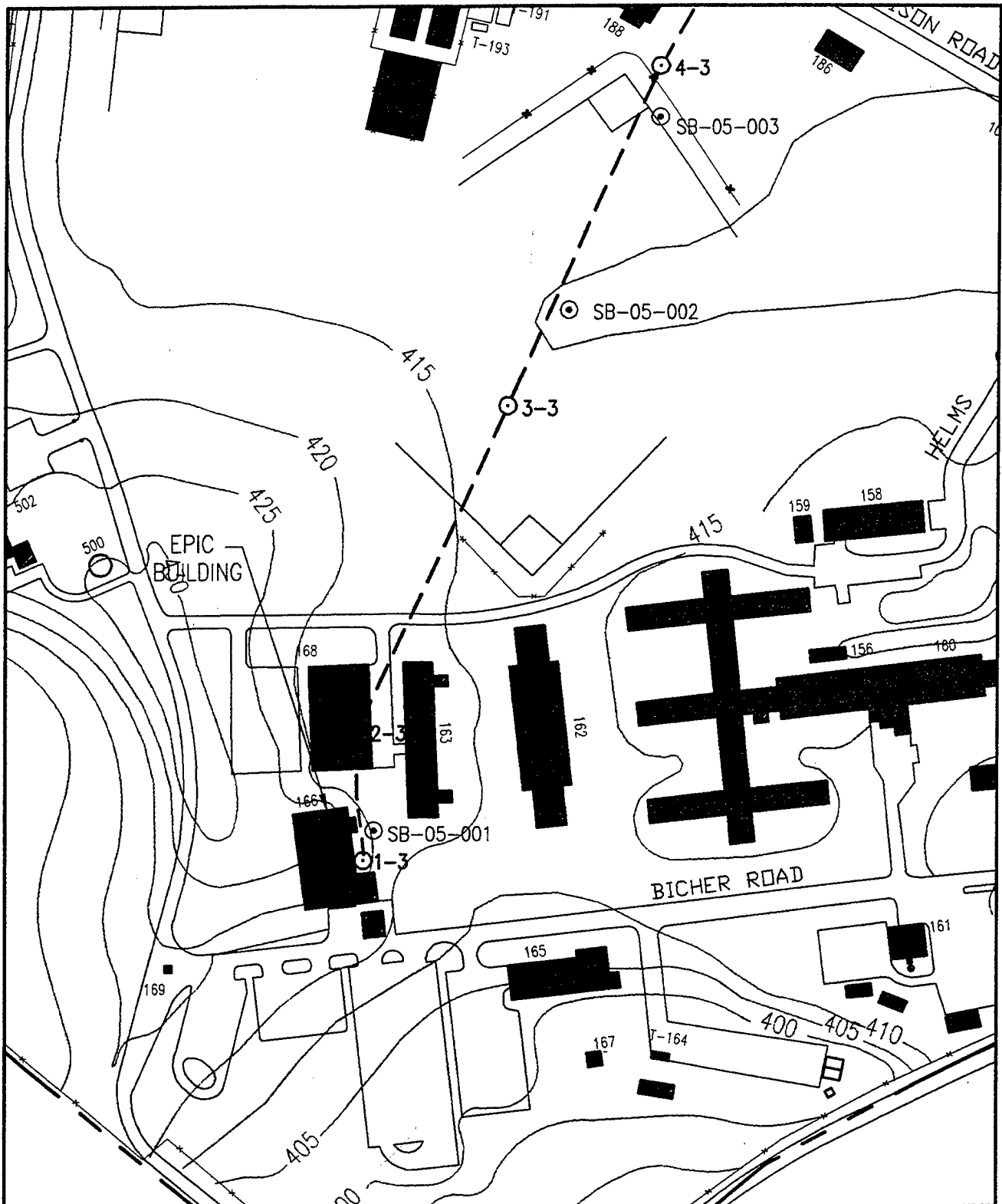
##### **3.6.5.1 Sewerline Video Survey**

The results of the sewerline video survey for the EPIC sewerline are provided in Appendix B and summarized in Section 2.2.3. Two of the six line sections could not be surveyed due to blockages caused by pipe collapse or thick sludges. Numerous bell cracks and pipe offsets were seen during the video survey and infiltration and exfiltration was noted at many points in each line section. The points with the greatest potential leaks were selected as locations for soil boring placements, as shown in Table 3-17. The borings were drilled approximately 2 feet from the sewerline to prevent accidental puncturing or collapse of the sewerline. The soil samples were collected at a depth just below the sewerline level.

##### **3.6.5.2 Soil Boring Results**

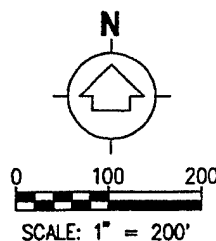
The results of the laboratory analyses for the EPIC sewerline are provided in Appendix J. Table 3-18 provides the results and residential soil RBCs for those contaminants that were





# **LEGEND:**

- BUILDING
- SITE DRAINAGE
- PAVED ROAD
- FENCE
- GROUNDWATER MONITORING WELL
- EPIC SEWERLINE
- 2-3 MANHOLE
- SOIL BORING

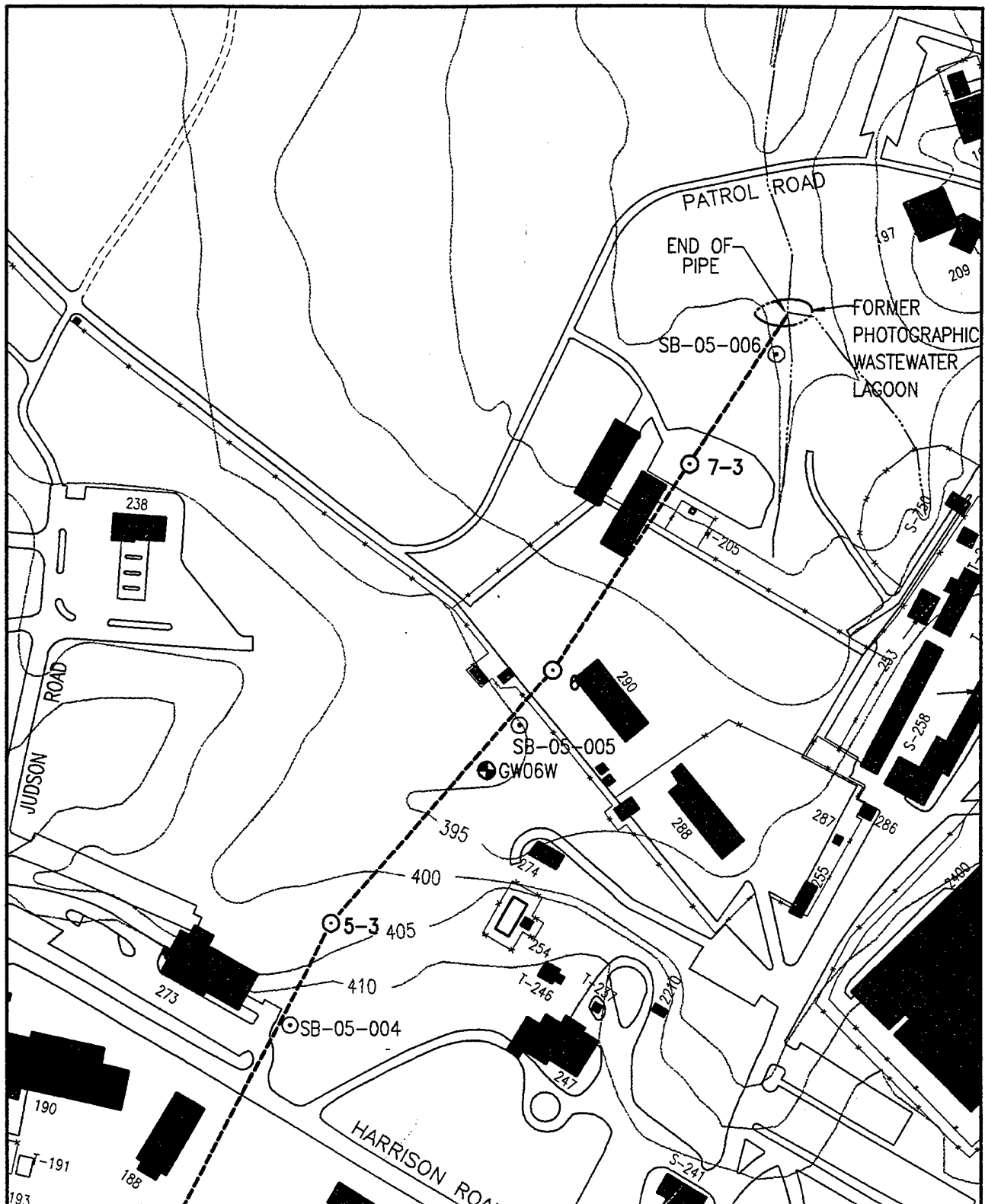


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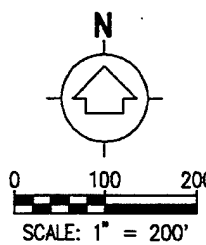
### **AREA 5 - EPIC BUILDING SEWERLINE, SOUTH SECTION**

Figure: 3-11	Project: 01-0827-03-6521-061	File Name: 95005\DWGS\036F3-4B	Date: 05-19-95
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**LEGEND:**

	BUILDING
	SITE DRAINAGE
	PAVED ROAD
	FENCE
	GROUNDWATER MONITORING WELL
	EPIC SEWERLINE
	MANHOLE
	SOIL BORING



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<b>VINT HILL FARMS STATION</b> <b>WARRENTON, VIRGINIA</b> <b>SI REPORT</b>			
<b>AREA 5 - EPIC BUILDING SEWERLINE, NORTH SECTION</b>			
Figure:	Project:	File Name:	Date:
3-12	01-0827-03-6521-061	95005\DWGS\036F3-4C	05-19-95

**Table 3-17. Soil Boring Locations at AREE 5 - EPIC Building  
Vint Hill Farms Station, Warrenton, Virginia**

Boring	Line Section	Location	Pipe Depth <sup>a</sup>	Boring Location Justification <sup>b</sup>
SB-05-001	1-3 to 2-3 to 3-3	41' from 1-3	7.8' BLS at 1-3 to 5.8' BLS at 3-3	Could not survey section due to major blockage in pipe. Evidence that the EPIC sewerline pipe was cut at this point (pieces of vitrified clay pipe found nearby) to install new drainage pipe. Soil sample collected at 9- to 11-foot interval.
SB-05-002	3-3 to 4-3	196' from 3-3	5.8' BLS at 3-3 to 12.9' BLS at 4-3	Video survey shows large offset at this point. Soil sample collected at 9- to 11-foot interval.
SB-05-003	3-3 to 4-3	7' from 4-3	5.8' BLS at 3-3 to 12.9' BLS at 4-3	Video survey shows large radial cracks and a hole at this point. Soil sample collected at 13- to 15-foot interval.
SB-05-004	4-3 to 5-3	127.5' from 5-3	12.9' BLS at 4-3 to 6.5' BLS at 5-3	Could not survey section due to major blockage in pipe. Blowback hose test indicates that the blockage is at this point. Soil sample collected at 10- to 12-foot interval.
SB-05-005	5-3 to 6-3	57' from 6-3	6.5' BLS at 5-3 to 6.5' BLS at 6-3	Video survey shows a separated joint at this point. Soil sample collected at 10- to 12-foot interval.
SB-05-006	6-3 to 7-3 to EOP	40' from EOP	6.5' BLS at 6-3 to 1' BLS at EOP	Video survey shows that the pipe changes from 6-inch vitrified clay pipe to 8-inch cast iron pipe at 33 feet from the EOP. Able to assume that the EPIC sewerline used to discharge to the Former Photographic Wastewater Lagoon (AREE 10) at the point where the 6-inch vitrified clay pipe ends. A point was selected at 40 feet from the EOP to determine leakages from the pipe as the lagoon was entered. Soil sample collected at 4- to 6-foot interval.

EOP - End of Pipe

<sup>a</sup> Pipe Depth measures the distance from the top of the manhole (not necessarily the ground surface) to the pipe invert.

<sup>b</sup> Details on each line section are provided in Table 2-2.

**Table 3-18. Data Summary Table: Soil - EPIC Building (AREE 5)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SB-05-001	SB-05-002	SB-05-003	SB-05-004	SB-05-005
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01
Site Type	BORE	BORE	BORE	BORE	BORE
Collection Date	11/2/94	11/2/94	11/3/94	11/3/94	11/3/94
Depth (ft)	9	9	13	10	10

<b>METALS/SOIL/CVAA (Y9) (ug/g)</b>					
Laboratory ID Number	UB06112	UB06113	UB06135	UB06136	UB06137
Parameter	Units	CRL	Units	CRL	Units
Mercury	ug/g	0.05	LT	0.05**	LT
					0.05**

<b>METALS/SOIL/GFAA (B9, JD20, JD21) (ug/g)</b>					
Laboratory ID Number	UB06112	UB06113	UB06135	UB06136	UB06137
Parameter	Units	CRL	Units	CRL	Units
Arsenic	ug/g	2.5	LT	2.5**	LT
Lead	ug/g	0.467	14.8**	19.9**	2.5**
			16.1**	21.2**	5.76**

<b>METALS/SOIL/ICP (JS12) (ug/g)</b>					
Laboratory ID Number	UB06112	UB06113	UB06135	UB06136	UB06137
Parameter	Units	CRL	Units	CRL	Units
Aluminum	ug/g	11.2	14100**	20800**	18800**
Barium	ug/g	3.29	32**	36.8**	119**
Beryllium	ug/g	0.427	LT	1.47**	1.52**
Calcium	ug/g	25.3	690**	178**	1140**
Cobalt	ug/g	2.5	4.45**	6.74**	21.8**
Chromium	ug/g	1.04	30.9**	42.3**	28.2**
Copper	ug/g	2.84	12.6**	20.4**	87.5**
Iron	ug/g	6.66	44200**	120000**	44700**
Potassium	ug/g	131	305**	1510**	1320**
Magnesium	ug/g	10.1	662**	1040**	5760**
Manganese	ug/g	9.87	191**	177**	195**
Sodium	ug/g	38.7	LT	LT	73.8**
Nickel	ug/g	2.74	4.59**	7.21**	23.8**
Vanadium	ug/g	1.14	80.7**	198**	45.4**
Zinc	ug/g	2.34	20.6**	38**	102**

Table 3-18. Data Summary Table: Soil - EPIC Building (AREE 5)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)

Site ID	Field Sample Number	Site Type	Collection Date	Depth (ft)
SB-05-001	SAIC01	BORE	11/2/94	9
SB-05-002	SAIC01	BORE	11/2/94	9
SB-05-003	SAIC01	BORE	11/3/94	13
SB-05-004	SAIC01	BORE	11/3/94	10
SB-05-005	SAIC01	BORE	11/3/94	10
<b>SEMIVOLATILES/SOIL/GCMS (LN25) (ug/g)</b>				
Laboratory ID Number	Parameter	Units	CRL	
		ug/g		
	TiCs		2 (1.3)	4 (3.1)
			3 (1.3)	3 (1.9)
				1 (0.5)

**Table 3-18. Data Summary Table: Soil - EPIC Building (AREE 5)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	SB-05-006	Residential RBCs	Adjusted RBCs
Field Sample Number	SAIC01		
Site Type	BORE		
Collection Date	11/3/94		
Depth (ft)	5		

<b>METALS/SOIL/CAA (Y9) (ug/g)</b>			
Laboratory ID Number	UB06138		
Parameter	Units	CRL	
Mercury	ug/g	0.05	23

<b>METALS/SOIL/GFAA (B9, JD20, JD21) (ug/g)</b>			
Laboratory ID Number	UB06138		
Parameter	Units	CRL	
Arsenic	ug/g	2.5	LT
Lead	ug/g	0.467	18.3**
			3.8n
			0.43c/23n
			N/A

<b>METALS/SOIL/ICP (JS12) (ug/g)</b>			
Laboratory ID Number	UB06138		
Parameter	Units	CRL	
Aluminum	ug/g	11.2	21800**
Barium	ug/g	3.29	266**
Beryllium	ug/g	0.427	1.7**
Calcium	ug/g	25.3	1990**
Cobalt	ug/g	2.5	56.9**
Chromium	ug/g	1.04	31.3**
Copper	ug/g	2.84	39.4**
Iron	ug/g	6.66	58500**
Potassium	ug/g	131	1560**
Magnesium	ug/g	10.1	3750**
Manganese	ug/g	9.87	3200**
Sodium	ug/g	38.7	70.6**
Nickel	ug/g	2.74	24.9**
Vanadium	ug/g	1.14	89.4**
Zinc	ug/g	2.34	82**
			78000
			5500
			0.15c/390n
			N/A
			4700
			390
			3100
			23000
			N/A
			N/A
			10850
			N/A
			1600
			550
			23000

**Table 3-18. Data Summary Table: Soil - EPIC Building (AREE 5 )  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	SB-05-006	Residential RBCs (EPA 1996)	Adjusted RBCs
Field Sample Number	SAIC01		
Site Type	BORE		
Collection Date	11/3/94		
Depth (ft)	5		
<b>SEMIVOLATILES/SOIL/GCMS (LM25) (ug/g)</b>			
Laboratory ID Number			
Parameter	Units	CRL	
	ug/g		
TICs	1 (1.0)		N/A

Footnotes:  
 \* - Data collected from chemical transfer file (Phase I)  
 \*\* - Data collected from USAEC Pyramid system (Phase III)  
 CRL - Certified reporting limit  
 ID - Identification  
 N/A - Not applicable  
 QC - Quality control  
 TICs - Tentatively Identified Compound: number of TICs (total value)  
 c - Carcinogenic effects  
 n - Noncarcinogenic effects  
 Boolean Codes  
 LT - Less than the certified reporting limit / method detection level

detected above the CRL. Six metals (arsenic, aluminum, beryllium, iron, manganese, and vanadium) were detected above their adjusted residential soil RBCs. No VOCs, SVOCs, or cyanide were detected above the CRL.

As shown in Table 3-19, the concentrations of aluminum, beryllium, iron, and vanadium were below background concentrations according to the UTL and t-tests. However, arsenic at SB-05-002 and SB-05-004 and manganese at SB-05-006 were not detected in the background soils or were above the UTL of the background soils, respectively. In addition, the concentrations of arsenic at these two borings were more than two standard deviations above the regional average (see Table 3-5).

A composite sample of the EPIC sewerline effluent from April 1978 contained significant concentrations of cyanide and silver with smaller concentrations of copper, calcium, magnesium, and iron (ESE 1981). In addition, review of the Material Safety Data Sheets (MSDSs) used within the EPIC Building shows that photographic chemicals such as starter (acetic acid), developer (sulfuric acid), fixer (sodium bisulfite), replenisher (hydroquinone), and bleach (potassium ferricyanide) were primarily used. Thus, the soils may not be contaminated by EPIC sewerline sludges because process-related organics and metals were not detected in the soil samples collected during the SI.

#### **3.6.5.3 Groundwater Sample Results**

The results of the laboratory analyses for the EPIC sewerline are provided in Appendix J. The groundwater sample results for the existing monitoring well (GW06W) are shown in Table 3-20. One VOC (pentachlorophenol) was detected in the duplicate sample at 2.05  $\mu\text{g/L}$ , which is above the tap water RBC and drinking water MCL (shown in Table 3-21). However, although pentachlorophenol may have been a constituent of the sewerline effluent, the presence of pentachlorophenol is considered suspect because it was detected in the duplicate and not the primary sample. No SVOCs or cyanide were detected above the CRL and none of the metals in the groundwater well was above the tap water RBCs or MCLs.



**Table 3-19. Background Soil Comparison-EPIC Building (AREE 5)  
Vint Hill Farms Station, Warrenton, Virginia**

Substance	AREE 5 SOIL					Differs from Background?	
	P,t,s	P,t,p	P,m-w	UTL (ppm)	% > UTL	Central Tendency (t-test, MW test)	Upper Tail (UTL test)
Aluminum	0.032	0.010		60600.00	0%	yes	no
Arsenic	-	-	-	-	-	yes; NDB	yes; NDB
Barium	-	-	-	-	-	-	-
Beryllium	0.858	0.838		5.10	0%	no	no
Cadmium	-	-	-	-	-	-	-
Calcium	-	-	-	-	-	-	-
Chromium	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-
Copper	-	-	-	-	-	-	-
Iron	0.276	0.248	-	180000.00	0%	no	no
Lead	-	-	-	-	-	-	-
Magnesium	-	-	-	-	-	-	-
Manganese	0.823	0.845		441.00	17%	no	yes
Mercury	-	-	-	-	-	-	-
Nickel	-	-	-	-	-	-	-
Potassium	-	-	-	-	-	-	-
Selenium	-	-	-	-	-	-	-
Silver	-	-	-	-	-	-	-
Sodium	-	-	-	-	-	-	-
Thallium	-	-	-	-	-	-	-
Vanadium	0.097	0.053		531.00	0%	no	no
Zinc	-	-	-	-	-	-	-

Notes:

P,t,s - t-test type I error probability assuming separate (or unequal) variances

P,t,p - t-test type I error probability assuming pooled (or equal) variances

P,m-w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples

**Table 3-20. Data Summary Table: Groundwater - EPIC Building (AREE 5)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID					
Field Sample Number					
Site Type					
Collection Date					
Depth (ft)					
GW06W					
SAIC01					
WELL					
11/7/94					
14.02					
Residential Tap Water RBCs (EPA 1996)					
Adjusted Tap Water RBCs					
<b>METALS/WATER/ICP (SS12, 6010) (ug/L)</b>					
Laboratory ID Number	Parameter	Units	CRL	UB06173	UB06174
	Aluminum	ug/L	112	680**	1280** D
	Barium	ug/L	2.82	66.7**	71.5** D
	Calcium	ug/L	105	5230**	5760** D
	Iron	ug/L	77.5	1590**	1210** D
	Magnesium	ug/L	135	3900**	4060** D
	Manganese	ug/L	9.67	52.8**	57.6** D
	Sodium	ug/L	279	8810**	8630** D
	Zinc	ug/L	18	24.1**	22.9** D
					37000
					2600
					N/A
					11000
					5500
					90
					N/A
					11000
<b>SEMI-VOLATILES/WATER/GCMS (UM25) (ug/L)</b>					
Laboratory ID Number	Parameter	Units	CRL	UB06173	UB06174
	TTCs	ug/L	1 (5.0)	1 (5.0)	N/A
<b>PHENOLS/WATER (B040) (ug/L)</b>					
Laboratory ID Number	Parameter	Units	CRL	UB06173	UB06174
	Pentachlorophenol	ug/L	1 LT	1** 9	2.05** D9
					0.56

**Footnotes:**

\* - Data collected from chemical transfer file (Phase I)

- Data collected from chemical transfer line (Phase I)
- Data collected from USAEC Pyramid system (Phase III)

CRL - Certified reporting limit

CRL - Certified reporting limit  
ID - Identification

ID - Identification  
N/A - Not applicable

N/A - Not applicable

**QC - Quality control**

TICs - Tentatively Identified Compound: number of TICs (total value)

## Boolean Codes

LT - Less than the certified reporting limit / method detection level

### LI - Less than the certain Flagging Codes

**Flagging Codes**  
D - Duplicate analysis.

D - Duplicate analysis.  
9 - Non-demonstrated / validated method performed for ISAEC.

**Table 3-21. ARARs Comparison for Groundwater at AREE 5 - EPIC Building  
Vint Hill Farms Station, Warrenton, Virginia**

Chemical	Proportion exceeding	Maximum Contaminant Level Comparison					Federal Status	Regulatory Source
		Site ID	Sample ID		Sample Conc. (µg/L)	MCL (µg/L)		
			Sample Type	Field Sample				
Pentachlorophenol	1	GW06W	WELL	SAIC02	2.0500	1	Final	Federal

SAIC01 - Samples collected by SAIC in November 1994

MCL - Maximum Contaminant Level

MCLG - Maximum Contaminant Level Goal

**Sources:**

Drinking Water Regulations and Health Advisories, EPA, February 1996, Office of Water, Washington, D.C.

Water Quality Criteria - 56 FR 223,58418 (Nov., 1991), "Amendments to the Water Quality Standards Regulation; Compliance with

CWA Section 303 (c)(2)(B); Proposed Rule" - Washington D.C.

State Drinking Water Standards - The Bureau of National Affairs, Inc. (BNA), CD-ROMS, August 1994

### 3.6.5.4 Streamlined Risk Assessment

A streamlined risk assessment was conducted for current and future land uses at AREE 5. Risks were calculated for the soil and groundwater ingestion pathways; however, only resident receptors were considered exposed to groundwater. For soil ingestion, as shown in Table 3-22, noncancer HIs did not exceed 1 and cancer risks did not exceed  $1 \times 10^{-4}$  for either the station or the construction worker. For residents ingesting soil, the noncancer HI exceeded 1 for the child, but the cancer risks did not exceed  $1 \times 10^{-4}$  for either residential receptor. The chemicals responsible for the child soil HI in excess of the target are arsenic and manganese. For residents ingesting groundwater, noncancer HIs did not exceed 1 and cancer risks did not exceed  $1 \times 10^{-4}$ .

**Table 3-22. Risk Characterization Summary for  
Soil and Groundwater Ingestion at the EPIC Building (AREE 5)**

Medium	Current Land Use				Future Land Use			
	Noncancer HI		Cancer Risk		Noncancer HI		Cancer Risk	
	Station Worker	Construction Worker	Station Worker	Construction Worker	Resident Child	Resident Adult	Resident Child	Resident Adult
Soil	0.2	1	1E-05	7E-06	3	0.3	4E-05	2E-05
Groundwater	NA	NA	NA	NA	0.2	0.09	7E-07	1E-06

### 3.6.5.5 Site Assessment

The six soil boring samples did not contain metals or organic compounds at concentrations greater than the residential soil RBCs and background levels with the exception of arsenic and manganese, which were not constituents of the EPIC sewerline effluent. According to the streamlined risk assessment, risks do not exceed EPA target levels under the current land use. Risks exceed EPA target levels under the future land use for children who would be exposed. However, the risk estimates are considered conservative because they were based on the maximum detected concentrations of chemicals and much of the risk is attributed to the toxic effects of naturally-occurring metals. In addition, the risks exceeded the EPA target levels only for the future land use and only for the child receptor. For these reasons, no further activities are recommended for the EPIC sewerline soils. However, EPA has requested additional sampling to further characterize this AREE.

The groundwater well sample did not contain metals or organic compounds at concentrations greater than tap water RBCs or MCLs with the exception of pentachlorophenol, which was detected in the duplicate sample only and is therefore considered suspect. Based on these results, an additional round of groundwater sampling at GW6W is recommended to confirm the presence of pentachlorophenol. However, according to the streamlined risk assessment, risks were within EPA target levels at these concentrations of pentachlorophenol. In addition, based on the video sewerline survey, sampling of the pipeline effluent is recommended. If effluent sampling results indicate that photographic sludge is still present in the pipeline, the sewerline should be properly abandoned.

### **3.6.6 AREE 7 - Electrical Equipment Facility Pretreatment Tank**

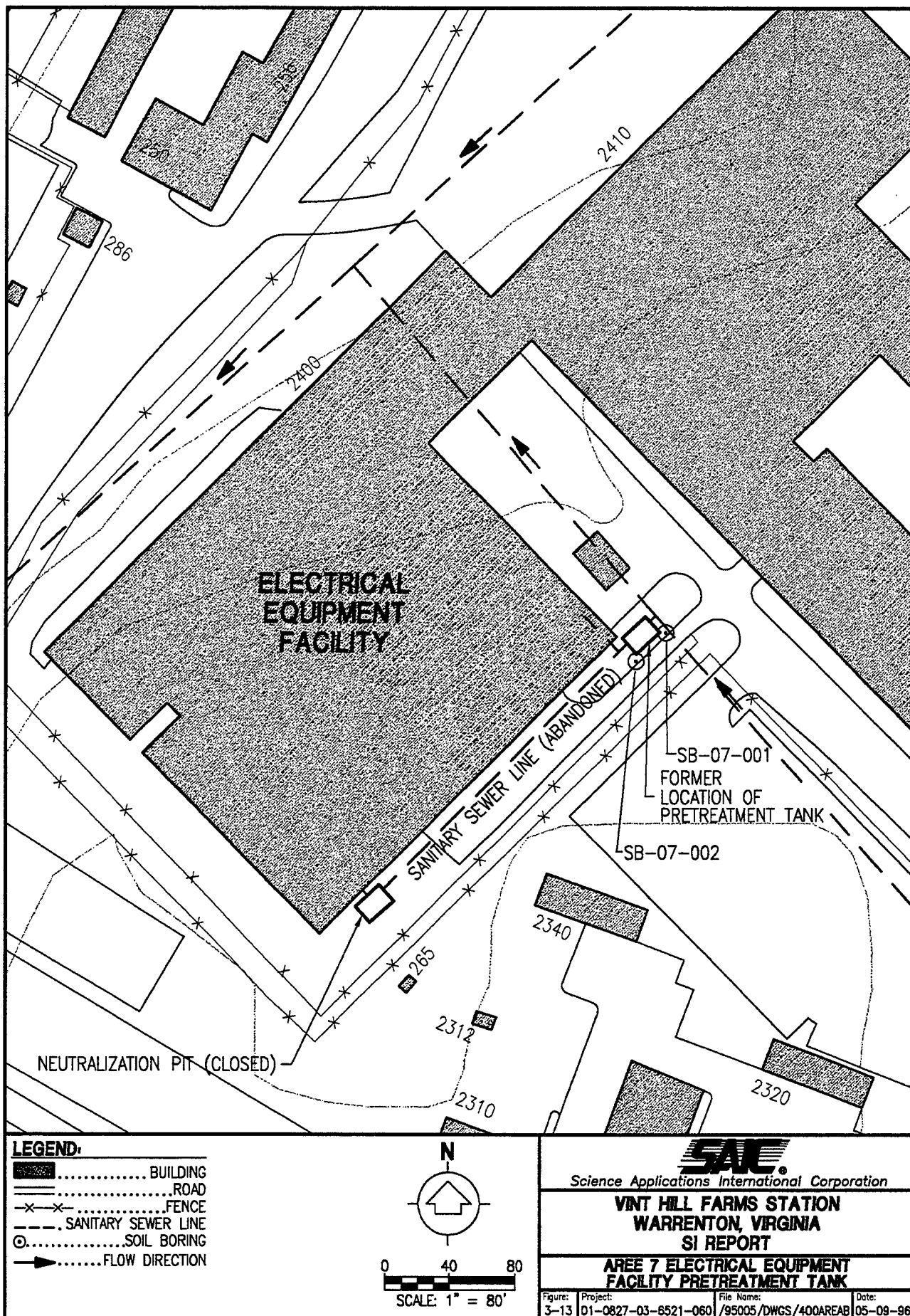
The Electrical Equipment Facility Pretreatment Tank discharged waste chromic acid from metal etching operations, painting wastewaters, and photographic wastewaters into an outside pretreatment tank. Sampling at this AREE consisted of drilling two soil borings around the outside pretreatment tank. One soil sample was collected from each borehole at the interval directly beneath the tank bottom at 2½ feet BLS. Figure 3-13 shows the locations of the soil borings at the Electrical Equipment Facility Pretreatment Tank. The target compounds at this AREE were VOCs, SVOCs, cyanide, and total metals.

#### **3.6.6.1 Soil Boring Results**

The results of the laboratory analyses for the Electrical Equipment Facility Pretreatment Tank are provided in Appendix J. Table 3-23 provides the results and residential soil RBCs for those contaminants detected above the CRL. Four metals (aluminum, beryllium, iron, and vanadium) were detected above their adjusted residential soil RBCs. However, as shown in Table 3-24, none of the concentrations were above the UTL of the background samples. No VOCs, SVOCs, or cyanide were detected above the CRL.

#### **3.6.6.2 Streamlined Risk Assessment**

A streamlined risk assessment was conducted for current and future land uses at AREE 7. Risks were calculated only for the soil ingestion pathway. As shown in Table 3-25, noncancer



**Table 3-23. Data Summary Table: Soil - Electrical Equipment Facility Pretreatment Tank (AREE 7)  
Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SB-07-001	SB-07-001	SB-07-002	Residential RBCs (EPA 1996)	Adjusted Residential RBCs
Field Sample Number	SAIC01	SAIC02	SAIC01		
Site Type	BORE	BORE	BORE		
Collection Date	11/7/94	11/7/94	11/7/94		
Depth (ft)	2.5	2.5	2.5		
<b>METALS/SOIL/OFPA (B9, JD20, JD21) (ug/g)</b>					
Laboratory ID Number	UB06169	UB06170	UB06171		
Parameter	Units	CRL			
Lead	ug/g	0.467	23.9**	14** D	11.8**
<b>METALS/SOIL/ICP (JS12) (ug/g)</b>					
Laboratory ID Number	UB06169	UB06170	UB06171		
Parameter	Units	CRL			
Aluminum	ug/g	11.2	56900** D	68.4** D	78000
Barium	ug/g	3.29	65.4**	0.918** D	5500
Beryllium	ug/g	0.427	1.07**	1060** D	0.15c/390n
Calcium	ug/g	25.3	1120**	45.3** D	N/A
Cobalt	ug/g	2.5	201**	28.4** D	4700
Chromium	ug/g	1.04	30.9**	29.8** D	390
Copper	ug/g	2.84	33.1**	130000** D	3100
Iron	ug/g	6.66	160000**	245** D	23000
Potassium	ug/g	131	213**	2960** D	N/A
Magnesium	ug/g	10.1	2770**	400** D	N/A
Manganese	ug/g	9.87	1460**	96.7** D	10950
Sodium	ug/g	38.7	97.8**	17.6** D	N/A
Nickel	ug/g	2.74	12.7**	355** D	1600
Vanadium	ug/g	1.14	442**	52.1** D	550
Zinc	ug/g	2.34	51.4**		23000
<b>SEMIVOLATILES/SOIL/OCMS (LM25) (ug/g)</b>					
Laboratory ID Number					
Parameter	Units	CRL			
TICs	ug/g	2 (1.4)	4 (1.8)	3 (1.8)	N/A

**Footnotes:**

- \* - Data collected from chemical transfer file (Phase I)
- \*\* - Data collected from USAEC Pyramid system (Phase III)
- CRL - Certified reporting limit
- ID - Identification
- N/A - Not applicable
- QC - Quality control
- TICs - Tentatively Identified Compound: number of TICs (total value)
- Boolean Codes
- LT - Less than the certified reporting limit / method detection level
- Flagging Codes
- D - Duplicate analysis.

**Table 3-24. Background Soil Comparison-Electrical Equipment Facility Pretreatment Tank (AREE 7)  
Vint Hill Farms Station, Warrenton, Virginia**

Substance	AREE 7 SOIL					Differs from Background?
	P,t,s	P,t,p	P,m-w	UTL (ppm)	% > UTL	
						Upper Tail (UTL test)
Aluminum	-	-	-	60600.00	0%	no
Arsenic	-	-	-	-	-	-
Barium	-	-	-	-	-	-
Beryllium	-	-	-	5.10	0%	no
Cadmium	-	-	-	-	-	-
Calcium	-	-	-	-	-	-
Chromium	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-
Copper	-	-	-	-	-	-
Iron	-	-	-	180000.00	0%	no
Lead	-	-	-	-	-	-
Magnesium	-	-	-	-	-	-
Manganese	-	-	-	-	-	-
Mercury	-	-	-	-	-	-
Nickel	-	-	-	-	-	-
Potassium	-	-	-	-	-	-
Selenium	-	-	-	-	-	-
Silver	-	-	-	-	-	-
Sodium	-	-	-	-	-	-
Thallium	-	-	-	-	-	-
Vanadium	-	-	-	531.00	0%	no
Zinc	-	-	-	-	-	-

**Notes:**

P,t,s - t-test type I error probability assuming separate (or unequal) variances

P,t,p - t-test type I error probability assuming pooled (or equal) variances

P,m-w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples



HIIs did not exceed 1 and cancer risks did not exceed  $1 \times 10^{-4}$  for either the station or the construction worker. Under a residential land use scenario, the noncancer HI exceeded 1 for the child; the cancer risks, however, did not exceed  $1 \times 10^{-4}$ . The chemicals responsible for the child HI in excess of the target are manganese and vanadium.

**Table 3-25. Risk Characterization Summary for  
Soil Ingestion at the Electrical Equipment Facility Pretreatment Tank (AREE 7)**

Current Land Use				Future Land Use			
Noncancer HI		Cancer Risk		Noncancer HI		Cancer Risk	
Station Worker	Construction Worker	Station Worker	Construction Worker	Resident Child	Resident Adult	Resident Child	Resident Adult
0.1	0.6	2E-06	9E-07	2	0.2	5E-06	3E-06

### 3.6.6.3 Site Assessment

VOCs, SVOCs, and cyanide were not detected above the CRL and metals were not detected above the adjusted residential soil RBCs, with the exception of aluminum, beryllium, iron, and vanadium, which were all within background levels. According to the streamlined risk assessment, risks do not exceed EPA target levels under the current land use. Risks exceed EPA target levels under the future land use for children who would be exposed. However, the risk estimates are considered conservative because they were based on the maximum detected concentrations of chemicals and much of the risk is attributed to the toxic effects of naturally-occurring metals. In addition, the risks exceeded the EPA target levels only for the future land use and only for the child receptor. For these reasons, no further sampling activities are recommended for the Electrical Equipment Facility Pretreatment Tank. However, additional actions may be necessary to complete the RCRA closure for this AREE.

### 3.6.7 AREE 9 - Vehicle Maintenance Area

The Vehicle Maintenance Area is used for general maintenance of military, government, and private vehicles. Small spills of oil, grease, gasoline, and cleaning solvents have been reported on the asphalt areas within the AREE. One neutralization pit is located outside each

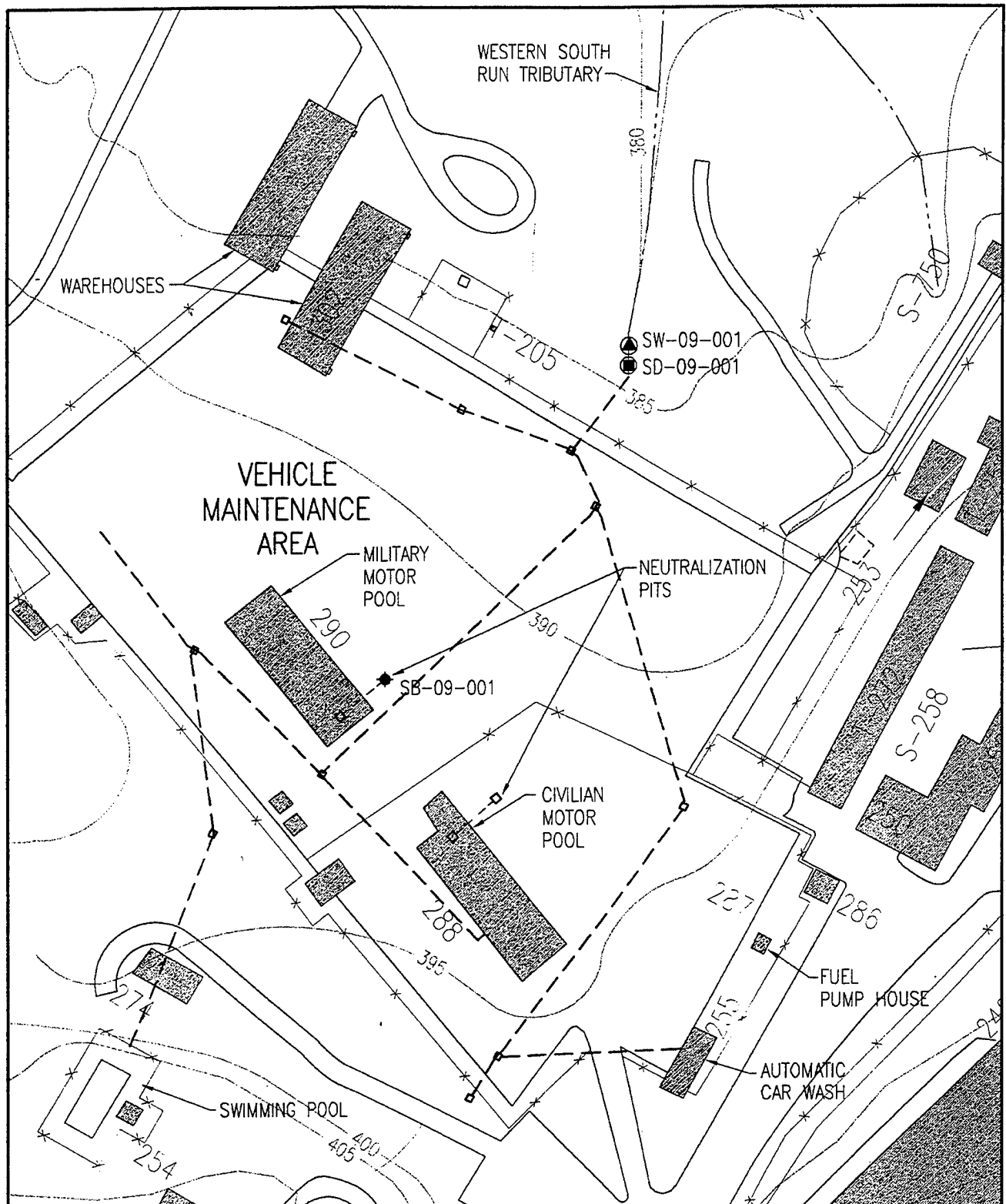
maintenance building (the civilian motor pool and the military motor pool) to receive wastewaters from the internal sinks. Planned sampling at this AREE consisted of collecting one soil sample beneath each neutralization pit and collecting a surface water sample and a sediment sample at the outlet of the storm sewer system to the western South Run tributary. However, because the neutralization pit outside the civilian motor pool (Building 288) had a concrete bottom, a soil sample was not collected at this point. Figure 3-14 shows the locations of the soil boring and the surface water and sediment sample. The target compounds at this AREE were VOCs, SVOCs, TPH, PCBs, pesticides, herbicides, and total metals.

#### **3.6.7.1 Soil Boring Results**

The results of the laboratory analyses for the Vehicle Maintenance Area are provided in Appendix J. Table 3-26 provides the results and residential soil RBCs for those contaminants that were detected above the CRL. Three metals (aluminum, beryllium, and iron) were detected above their adjusted residential soil RBCs in the soil boring. However, as shown in Table 3-27, none of the concentrations was above the UTL of the background samples. One SVOC (2-methylnaphthalene) and seven pesticides (aldrin, endosulfan II, endrin aldehyde, endrin ketone, endosulfan sulfate, lindane, and 2,2-bis[p-chlorophenyl]-1,1,1-trichloroethane) were detected beneath the neutralization pit at low concentrations. However, five of these pesticides (endosulfan II, endrin aldehyde, endrin ketone, endosulfan sulfate, and 2,2-bis[p-chlorophenyl]-1,1,1-trichloroethane) were flagged with a "U," indicating unconfirmed concentrations. TPH also was detected beneath the neutralization pit at a concentration of 8,440  $\mu\text{g/g}$ , which exceeds the TPH action level of 100 ppm. No VOCs were detected above the CRL in the soils that were sampled from beneath the neutralization pit.

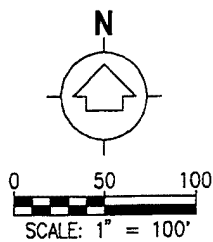
#### **3.6.7.2 Sediment Results**

The results of the laboratory analyses for the Vehicle Maintenance Area are provided in Appendix J. Table 3-26 provides the results and the National Oceanic and Atmospheric Administration (NOAA) ER-L concentrations for those compounds and analytes that were detected above the CRL. Two metals (lead and zinc) were detected above their respective ER-L concentrations. Four pesticides (endosulfan I, chlordane, dieldrin, and heptachlor epoxide) also were detected in the creek sediments. However, endosulfan I was flagged with a "U," indicating



**LEGEND:**

- BUILDING
- FENCE
- ROAD
- CATCH BASIN W/SANITARY SEWER
- SURFACE WATER SAMPLE
- SOIL BORING
- SEDIMENT SAMPLE



Science Applications International Corporation

**VINT HILL FARMS STATION  
WARRENTON, VIRGINIA  
SI REPORT**

**AREA 9 - VEHICLE MAINTENANCE AREA**

Figure: 3-14	Project: 01-0827-03-6521-060	File Name: /95005/DWGS/036AR10B	Date: 03-28-95
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**Table 3-26. Data Summary Table: Soil and Sediment - Vehicle Maintenance Area (AREE 9)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SB-09-001	SD-09-001	SD-09-001	Residential RBCs Adjusted RBCs (EPA 1996) For Soil	ER-L (NOAA, 1991) For Sediment	ER-M (NOAA, 1991) For Sediment
Field Sample Number	SAIC01	SAIC01	SAIC02			
Site Type	BORE	CREK	CREK			
Collection Date	11/7/94	11/4/94	11/4/94			
Depth (ft)	1.87	0	0			
Matrix	Soil	Sediment	Sediment			

<b>METALS/SOIL/CAA (Y9) (ug/g)</b>	
Laboratory ID Number	UB06162
Parameter	
Mercury	Units CRL ug/g 0.05
	LT 0.05** D 23 0.15 1.3

<b>METALS/SOIL/GFAA (B9, JD20, JD21) (ug/g)</b>	
Laboratory ID Number	UB06161
Parameter	
Arsenic	Units CRL ug/g 2.5
Lead	ug/g 0.467
	LT 2.5** 3.79** 5.71** D 0.43c/23n 33 85 31** D 35 110

<b>METALS/SOIL/ICP (JS12) (ug/g)</b>	
Laboratory ID Number	UB06162
Parameter	
Aluminum	Units CRL ug/g 11.2
Barium	ug/g 3.29
Beryllium	ug/g 0.427
Calcium	ug/g 25.3
Cobalt	ug/g 2.5
Chromium	ug/g 1.04
Copper	ug/g 2.84
Iron	ug/g 6.66
Potassium	ug/g 131
Magnesium	ug/g 10.1
Manganese	ug/g 9.87
Sodium	ug/g 38.7
Nickel	ug/g 2.74
Vanadium	ug/g 1.14
Zinc	ug/g 2.34
	LT 2.5** 3.79** 5.71** D 0.43c/23n 33 85 31** D 35 110

<b>SEMIVOLATILES/SOIL/GCMS (LM25) (ug/g)</b>	
Laboratory ID Number	UB06161
Parameter	
2-Methylnaphthalene	Units CRL ug/g 0.032
TICs	ug/g 73 (1469.0)
	LT 0.032** 10 (4.7) N 65 270

**Table 3-26. Data Summary Table: Soil and Sediment - Vehicle Maintenance Area (AREE 9)**  
**Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	SB-09-001	SD-09-001	SD-09-001	Residential RBCs Adjusted RBCs	ER-L	ER-M
Field Sample Number	SAIC01	SAIC01	SAIC02	For Soil	(NOAA, 1991)	(NOAA, 1991)
Site Type	BORE	CREK	CREK	For Sediment	For Sediment	For Sediment
Collection Date	11/7/94	11/4/94	11/4/94			
Depth (ft)	1.67	0	0			
Matrix	Soil	Sediment	Sediment			

<b>PESTICIDES/SOIL/GC/EC (LH17) (ug/g)</b>									
Laboratory ID Number	UB06172	UB06161	N/A						
Parameter	Units	CRL							
Endosulfan I	ug/g	0.001	LT	0.001**	U	0.00197**	N/A	470	N/A
Aldrin	ug/g	0.0014		0.00218**	C	0.0014**	N/A	0.038	N/A
Endosulfan II	ug/g	0.0007		0.00177**	U	0.0007**	N/A	470	N/A
Chlordane	ug/g	0.0684	LT	0.0684**		0.281**	C	0.49	6
Dieldrin	ug/g	0.0016	LT	0.0016**	C	0.00716**	C	0.04	8
Endrin Aldehyde	ug/g	3.3		0.0018**	ZU	0.0005**	T	N/A	N/A
Endrin Ketone	ug/g	3.3		0.00384**	ZU	0.0005**	T	N/A	N/A
Endosulfan Sulfate	ug/g	0.0005		0.0416**	ZU	0.0005**	T	470**	N/A
Heptachlor Epoxide	ug/g	0.0013	LT	0.0013**	C	0.00193**	C	0.07	N/A
Lindane	ug/g	0.001		0.00135**	C	0.001**		0.49	N/A
2,2-bis(p-Chlorophenyl)-1,1-trichloroethane	ug/g	0.0035		0.00737**	U	0.0035**		1.9	7

<b>TRPH/Soil (EPA 418.1) (ug/g)</b>									
Laboratory ID Number	UB06172	UB06161	N/A						
Parameter	Units	CRL							
Total Petroleum Hydrocarbons	ug/g	10		8440**		399**	N/A	N/A	N/A

<b>HERBICIDES/Soil/GC/EC (LH19) (ug/g)</b>									
Laboratory ID Number	UB06172	UB06161	UB06162						
Parameter	Units	CRL							
2,4,5-T	ug/g	0.0356		0.0721**	U	LT	0.0356**	D	N/A
2,4-D	ug/g	0.03		0.0683**	C		0.371**	UD	N/A

**Footnotes:**

\* - Data collected from chemical transfer file (Phase I)  
 \*\* - Data collected from USAEC Pyramid system (Phase III)  
 \*\*\* - RBC for endosulfan; a chemically-similar compound

For analytes flagged with "A," "G," "B," "U," or "I," half the detected value was compared with the RBC.

CRL - Certified reporting limit

ID - Identification

N/A - Not applicable

QC - Quality control

TICs - Tentatively Identified Compound: number of TICs (total value)

g - Carcinogenic effects.

n - Noncarcinogenic effects.

Boolean Codes

LT - Less than the certified reporting limit / method detection level

Flagging Codes

D - Duplicate analysis

C - Analysis was confirmed.

T - Non-target compound analyzed for but not detected (non-GC/MS methods).

Z - Non-target compound analyzed for and detected (non-GC/MS methods).

U - Analysis is unconfirmed.

Data qualifiers

N - The high spike recovery is low.

**Table 3-27. Background Soil Comparison-Vehicle Maintenance Area (AREE 9)  
Vint Hill Farms Station, Warrenton, Virginia**

Substance	AREE 9 SOIL					Differs from Background?
	P,t,s	P,t,p	P,m-w	UTL (ppm)	% > UTL	Upper Tail (UTL test)
Aluminum	-	-	-	60600.00	0%	no
Arsenic	-	-	-	-	-	-
Barium	-	-	-	-	-	-
Beryllium	-	-	-	5.10	0%	no
Cadmium	-	-	-	-	-	-
Calcium	-	-	-	-	-	-
Chromium	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-
Copper	-	-	-	-	-	-
Iron	-	-	-	180000.00	0%	no
Lead	-	-	-	-	-	-
Magnesium	-	-	-	-	-	-
Manganese	-	-	-	-	-	-
Mercury	-	-	-	-	-	-
Nickel	-	-	-	-	-	-
Potassium	-	-	-	-	-	-
Selenium	-	-	-	-	-	-
Silver	-	-	-	-	-	-
Sodium	-	-	-	-	-	-
Thallium	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-
Zinc	-	-	-	-	-	-

**Notes:**

P,t,s - t-test type I error probability assuming separate (or unequal) variances

P,t,p - t-test type I error probability assuming pooled (or equal) variances

P,m-w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples

unconfirmed concentrations. TPH was detected in the creek sediments at a concentration of 399  $\mu\text{g/g}$ , which exceeds the state action level of 100 ppm. No VOCs were detected in the creek sediments above the CRL.

#### **3.6.7.3 Surface Water Sample Results**

The results of the laboratory analyses for the Vehicle Maintenance Area are provided in Appendix J. The surface water sample results are provided in Table 3-28. Three VOCs (trichloroethene, vinyl chloride, and 1,1-dichloroethene), one pesticide (dieldrin), and one phenol (pentachlorophenol) were detected above the tap water RBCs. However, vinyl chloride was flagged with an "A" to indicate that the analyte was found in the trip blank. As shown in Table 3-29, dieldrin also was above AWQC for human health and fresh water. In addition, TPH was detected at 333  $\mu\text{g/L}$ . No PCBs were detected in the surface water.

#### **3.6.7.4 Site Assessment**

Metals, VOCs, SVOCs, TPH, and pesticides were detected above their CRLs in soil, sediment, and surface water samples in both the creek and in the soils beneath the neutralization pit. The contaminants in the creek and neutralization pit are indicative of contamination from vehicle maintenance operations and pesticide spills or applications. Tap water RBCs and AWQC were exceeded in the surface water; NOAA ER-L concentrations and TPH state action levels were exceeded in the sediments; and residential soil RBCs and TPH state action levels were exceeded in the soils beneath the neutralization pit. Based on these results, further activities are recommended for the Vehicle Maintenance Area to characterize the full extent of contamination in the soils beneath the neutralization pit and the extent and migration of contaminants toward the western South Run tributary.

#### **3.6.8 AREE 10 - Former Photographic Wastewater Lagoon**

The Former Photographic Wastewater Lagoon was an earthen holding pond used to receive EPIC Building (AREE 5) photographic wastewaters from 1958 to 1968. The lagoon was dredged in 1968 to recover silver from the sediments and then refilled with soil. Sampling at this AREE consisted of drilling three soil borings within the area of the lagoon and sampling the

**Table 3-28. Data Summary Table: Surface Water-Vehicle Maintenance Area (AREE 9)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SW-09-001	Residential Tap Water RBCs
Field Sample Number	SAIC01	(EPA 1996)
Site Type	CREK	
Collection Date	11/4/94	
Depth (ft)	0	

<b>METALS/WATER/ICP (SS12, 8010) (ug/L)</b>		
Laboratory ID Number	UB06163	
Parameter	Units	CRL
Barium	ug/L	2.82
Calcium	ug/L	105
Potassium	ug/L	1240
Magnesium	ug/L	135
Manganese	ug/L	9.67
Sodium	ug/L	279
Zinc	ug/L	18

<b>VOLATILES/WATER/GCMS (UM21) (ug/L)</b>		
Laboratory ID Number	UB06163	
Parameter	Units	CRL
1,1-Dichloroethene	ug/L	1
Trichloroethene	ug/L	1
TICs	ug/L	1 (10.0)

<b>SEMI-VOLATILES/WATER/GCMS (UM25) (ug/L)</b>		
Laboratory ID Number	UB06163	
Parameter	Units	CRL
TICs	ug/L	0 (0.0)

<b>HALOGENATED VOLATILE ORGANICS/WATER (8010) (ug/L)</b>		
Laboratory ID Number	UB06163	
Parameter	Units	CRL
Vinyl Chloride	ug/L	1

<b>PHENOLS/WATER (8040) (ug/L)</b>		
Laboratory ID Number	UB06163	
Parameter	Units	CRL
Pentachlorophenol	ug/L	1



**Table 3-28. Data Summary Table: Surface Water-Vehicle Maintenance Area (AREE 9)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	SW-09-001	Residential Tap Water RBCs
Field Sample Number	SAIC01	(EPA 1996)
Site Type	CREK	
Collection Date	11/4/94	
Depth (ft)	0	
Associated Field QC Sample - Site ID		
Associated Field QC Sample - Field Sample No.		
Associated Field QC Sample - Site ID		
Associated Field QC Sample - Field Sample No.		
<b>PESTICIDES/WATER/CEC (UH20) (ug/L)</b>		
Laboratory ID Number	UB06163	
Parameter	Units	CRL
Endosulfan I	ug/L	0.003
Dieldrin	ug/L	0.007
		220
		0.0042
<b>TRPH/WATER (EPA 418.1) (ug/L)</b>		
Laboratory ID Number	UB06163	
Parameter	Units	CRL
Total Petroleum Hydrocarbons	ug/L	100
		333**
		N/A

**Footnotes:**

- \* - Data collected from chemical transfer file (Phase I)
- \*\* - Data collected from USAEC Pyramid system (Phase III)
- CRL - Certified reporting limit
- ID - Identification
- N/A - Not applicable
- QC - Quality control
- TICs - Tentatively Identified Compound: number of TICs (total value)
- Flagging Codes
- C - Analysis was confirmed.
- U - Analysis is unconfirmed.
- Data Qualifiers
- M - The high-spike recovery is high.

**Table 3-29. ARARs Comparison for Surface Water at AREE 9 - Vehicle Maintenance Area  
Vint Hill Farms Station, Warrenton, Virginia**

Chemical	Proportion Exceeding	Ambient Water Quality Criteria Comparison for Human Health				
		Site ID		Sample ID		HH_ORG (µg/L)
		Site ID	Sample Type	Field Sample	Sample Conc. (µg/L)	
Dieldrin	1/1	SW-09-001	CREK	SAIC01	0.01730	0.00014 (c)

Chemical	Proportion exceeding	Ambient Water Quality Criteria Comparison for Freshwater				
		Site ID		Sample ID		FW (µg/L)
		Site ID	Sample Type	Field Sample	Sample Conc. (µg/L)	
Dieldrin	1/1	SW-09-001	CREK	SAIC01	0.01730	0.00190

AWQC - Ambient Water Quality Comparison  
 ESE - Samples collected by ESE in August 1984  
 SAIC01 - Samples collected by SAIC in November 1994  
 HH\_ORG - Human Health for Consumption of Organisms Only  
 FW - Freshwater Criterion Continuous  
 CREK - Creek sample  
 (c) - criteria designated as organoleptic are based on taste and odor effects, not human health effects. Health based WQC are not available for these chemicals.

Sources:  
 Drinking Water Regulations and Health Advisories, EPA, February 1996, Office of Water, Washington, D.C.  
 Water Quality Criteria - 56 FR 223.58418 (Nov., 1991), "Amendments to the Water Quality Standards Regulation; Compliance with CWA Section 303 (c)(2)(B); Proposed Rule" - Washington D.C.  
 State Drinking Water Standards - The Bureau of National Affairs, Inc. (BNA), CD-ROMS, August 1994

existing groundwater monitoring well downgradient from the lagoon. One soil sample was collected from each borehole at the approximate location of the lagoon bottom (i.e., in the 3- to 5-foot BLS interval). An additional planned soil boring in the southeast quadrant was not drilled because the location was inaccessible to the drilling. Figure 3-15 shows the locations of the soil borings and monitoring well at the Former Photographic Wastewater Lagoon. The target compounds at this AREE were total metals, cyanide, and anions (for the groundwater sample).

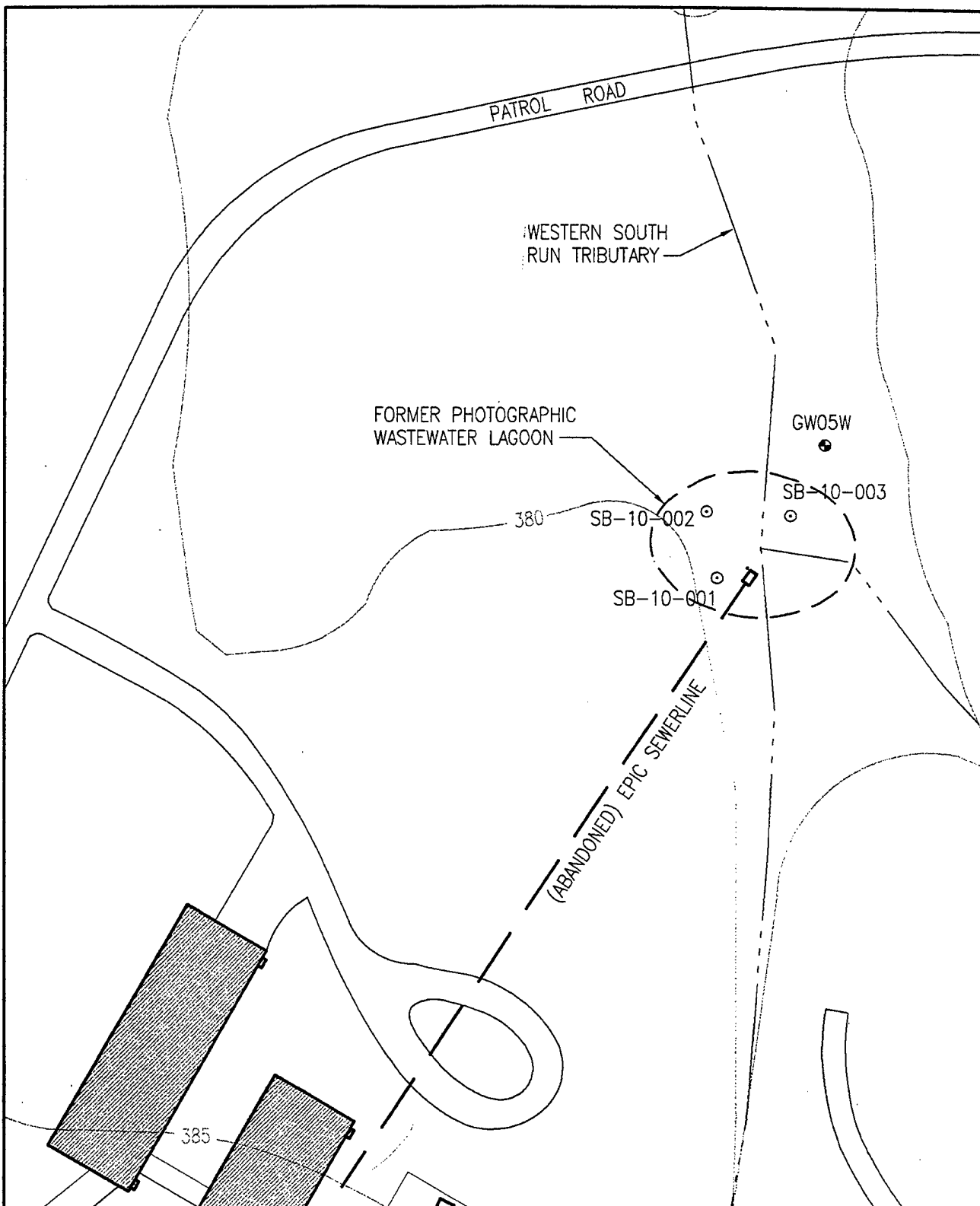
#### **3.6.8.1 Soil Boring Results**

The results of the laboratory analyses for the Former Photographic Wastewater Lagoon are provided in Appendix J. Table 3-30 provides the results and residential soil RBCs for those contaminants detected above the CRL. Three metals (aluminum, beryllium, and iron) were detected at concentrations above their respective adjusted residential soil RBCs. However, as shown in Table 3-31, the concentrations of aluminum, beryllium, and iron were below the background UTLs. Cyanide was not detected above the CRL.

The EPIC sewerline effluent, which discharged into this AREE, contained high concentrations of silver and cyanide. The absence of cyanide in the soil samples collected from the former lagoon and the low concentration of silver in only one soil sample (at 53.2  $\mu\text{g/g}$ ) indicates that most of the contaminated sediments from the former lagoon had been removed during the 1968 dredging.

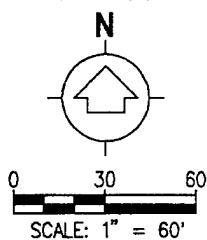
#### **3.6.8.2 Groundwater Sample Results**

The results of the laboratory analyses for the Former Photographic Wastewater Lagoon are provided in Appendix J. The groundwater sample results for the existing monitoring well are shown in Table 3-32. Four metals (beryllium, manganese, nickel, and thallium) and one anion (fluoride) were detected at concentrations above their adjusted tap water RBCs. In addition, as shown in Table 3-33, three metals (beryllium, nickel, and thallium) also exceeded the drinking water MCLs. Cyanide was not detected above the CRL. Well GW05W is at a location where it is influenced by many potential sources, including the Vehicle Maintenance Area (AREE 9), Former STP (AREE 11), and runoff from the industrial sector of the facility.



**LEGEND:**

- BUILDING
- STREAM
- ROAD
- SOIL BORING
- GROUNDWATER MONITORING WELL



Science Applications International Corporation

**VINT HILL FARMS STATION  
WARRENTON, VIRGINIA  
SI REPORT**

**AREA 10-FORMER PHOTOGRAPHIC WASTEWATER LAGOON**

Figure: 3-15	Project: 01-0827-03-6521-060	File Name: /95005/DWGS/036AR12B	Date: 03-28-95
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**Table 3-30. Data Summary Table: Soil - Former Photographic Wastewater Lagoon (AREE 10)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SB-10-001	SB-10-002	SB-10-003	Residential RBCs (EPA 1996)
Field Sample Number	SAIC01	SAIC01	SAIC01	
Site Type	BORE	BORE	BORE	
Collection Date	11/4/94	11/4/94	11/4/94	
Depth (ft)	4	3	3	

<b>METALS/SOIL/CVAA (Y9) (ug/g)</b>				
Laboratory ID Number	UB06149	UB06150	UB06151	
Parameter	Units	CRL		
Mercury	ug/g	0.05	LT	0.05**
				23

<b>METALS/SOIL/GFAA (B9, JD20, JD21) (ug/g)</b>				
Laboratory ID Number	UB06149	UB06150	UB06151	
Parameter	Units	CRL		
Lead	ug/g	0.467	30**	3.6**
				N/A

<b>METALS/SOIL/ICP (J512) (ug/g)</b>				
Laboratory ID Number	UB06149	UB06150	UB06151	
Parameter	Units	CRL		
Aluminum	ug/g	11.2	24800**	15400**
Barium	ug/g	3.29	144**	74.4**
Beryllium	ug/g	0.427	1.29**	0.774**
Calcium	ug/g	25.3	2230**	8430**
Cobalt	ug/g	2.5	21.3**	19.7**
Chromium	ug/g	1.04	38.6**	32.9**
Copper	ug/g	2.84	23.7**	2.84**
Iron	ug/g	6.66	54900**	3100
Potassium	ug/g	131	1640**	23000
Magnesium	ug/g	10.1	2250**	N/A
Manganese	ug/g	9.87	835**	N/A
Silver	ug/g	0.803	LT	10850
Sodium	ug/g	38.7	0.803**	33.2**
Nickel	ug/g	2.74	62.6**	134**
Vanadium	ug/g	1.14	14**	21.4**
Zinc	ug/g	2.34	109**	54.1**
				138
				23000

Footnotes:  
 \* - Data collected from chemical transfer file (Phase I)  
 \*\* - Data collected from USAEC Pyramid system (Phase III)  
 CRL - Certified reporting limit  
 ID - Identification  
 N/A - Not applicable  
 QC - Quality control  
 TICs - Tentatively Identified Compound: number of TICs (total value)  
 Boolean Codes  
 LT - Less than the certified reporting limit/method detection level

**Table 3-31. Background Soil Comparison-Former Photographic Wastewater Lagoon (AREE 10)  
Vint Hill Farms Station, Warrenton, Virginia**

Substance	AREE 10 SOIL					Differs from Background?
	P,t,s	P,t,p	P,m-w	UTL (ppm)	% > UTL	
						Upper Tail (UTL test)
Aluminum	-	-	-	60600.00	0%	no
Arsenic	-	-	-	-	-	-
Barium	-	-	-	-	-	-
Beryllium	-	-	-	5.10	0%	no
Cadmium	-	-	-	-	-	-
Calcium	-	-	-	-	-	-
Chromium	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-
Copper	-	-	-	-	-	-
Iron	-	-	-	180000.00	0%	no
Lead	-	-	-	-	-	-
Magnesium	-	-	-	-	-	-
Manganese	-	-	-	-	-	-
Mercury	-	-	-	-	-	-
Nickel	-	-	-	-	-	-
Potassium	-	-	-	-	-	-
Selenium	-	-	-	-	-	-
Silver	-	-	-	-	-	-
Sodium	-	-	-	-	-	-
Thallium	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-
Zinc	-	-	-	-	-	-

**Notes:**

P,t,s - t-test type I error probability assuming separate (or unequal) variances

P,t,p - t-test type I error probability assuming pooled (or equal) variances

P,m-w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples

**Table 3-32. Data Summary Table: Groundwater - Former Photographic Wastewater Lagoon (AREE 10)  
Vint Hill Farms Station, Warrenton, Virginia**

Site ID	GW05W	GW05W	GW05W	Adjusted Tap Water RBCs For Groundwater
Field Sample Number	SAIC01	SAIC02	SAIC02	For Groundwater
Site Type	WELL	WELL	WELL	
Collection Date	11/10/94	11/10/94	11/10/94	
Depth (ft)	12.08	12.08	12.08	
Associated Field QC Sample - Site ID				
Associated Field QC Sample - Field Sample No.				
Associated Field QC Sample - Site ID				
Associated Field QC Sample - Field Sample No.				
<b>METALS/WATER/ICP (SS12, 6010) (ug/L)</b>				
Laboratory ID Number	UB06220	UB06221	UB06221	
Parameter	Units	CRL	Units	CRL
Aluminum	ug/L	112	112**	37000
Barium	ug/L	2.82	278**	2600
Beryllium	ug/L	1.12	4.43**	0.016c/182n
Calcium	ug/L	105	123000**	N/A
Iron	ug/L	77.5	232**	11000
Potassium	ug/L	1240	3750**	352** D
Magnesium	ug/L	135	32100**	3540** D
Manganese	ug/L	9.67	1780**	31600** D
Sodium	ug/L	279	79300**	2540** D
Nickel	ug/L	32.1	171**	80300** D
Thallium	ug/L	2.44	3.67**	193** D
				2.9
				0.58
<b>ANIONS/WATER/IONCHROM (TT09) (ug/L)</b>				
Laboratory ID Number	UB06220	UB06221	UB06221	
Parameter	Units	CRL	Units	CRL
Bromide	ug/L	407	678**	N/A
Chloride	ug/L	278	59000**	N/A
Fluoride	ug/L	153	1200**	2200
Sulfate	ug/L	175	39000**	N/A
				440
<b>ANIONS/WATER/TECHNICON (LL8) (ug/L)</b>				
Laboratory ID Number	UB06220	UB06221	UB06221	
Parameter	Units	CRL	Units	CRL
Nitrite, Nitrate	ug/L	10	280**	3700**
				280** D
<b>INORGANIC/WATER/TECHNICON (TF29) (ug/L)</b>				
Laboratory ID Number	UB06220	UB06221	UB06221	
Parameter	Units	CRL	Units	CRL
Phosphate	ug/L	10	19.2** G	32.8** DG
				N/A

**Footnotes:**

\* - Data collected from chemical transfer file (Phase I)  
 \*\* - Data collected from USAEC Pyramid system (Phase III)

\*\*\* - RBC for nitrite.

CRL - Certified reporting limit

ID - Identification

N/A - Not applicable

QC - Quality control

**Boolean Codes**

LT - Less than the certified reporting limit / method detection level

**Flagging Codes**

D - Duplicate analysis.

G - Analyte found in the rinse blank as well as field sample.

For analytes flagged with "A," "G," "B," "U," or "I," half the detected value was compared with the RBC.

**Table 3-33. ARARs Comparison for Groundwater at AREE 10 - Former Photographic Wastewater Lagoon  
Vint Hill Farms Station, Warrenton, Virginia**

Chemical	Proportion exceeding	Maximum Contaminant Level Comparison					Federal Status	Regulatory Source
		Sample ID			Sample Conc. (µg/L)	MCL (µg/L)		
		Site ID	Sample Type	Field Sample				
Beryllium	1/1	GW05W	WELL	SAIC01	4.4300	4	Final	Federal
Nickel	1/1	GW05W	WELL	SAIC01	171.0000	100	Final	Federal
Thallium	1/1	GW05W	WELL	SAIC01	3.6700	2	Final	Federal

Chemical	Maximum Contaminant Level Goal Comparison							Federal Status	Regulatory Source
	Proportion exceeding	Sample ID		Sample Conc. (µg/L)	MCLG (µg/L)				
		Site ID	Sample Type			Field Sample			
Beryllium	1/1	GW05W	WELL	SAIC01	4.4300	4		Final	Federal
Nickel	1/1	GW05W	WELL	SAIC01	171.0000	100		Final	Federal
Lead	1/2	GW05W	WELL	ESE	15.1000	0		Final	Federal
Thallium	1/1	GW05W	WELL	SAIC01	3.6700	0.5		Final	Federal

ESE - Samples collected by ESE in August 1984  
 SAIC01 - Samples collected by SAIC in November 1994  
 MCL - Maximum Contaminant Level  
 MCLG - Maximum Contaminant Level Goal

Sources:  
 Drinking Water Regulations and Health Advisories, EPA, February 1996, Office of Water, Washington, D.C.  
 Water Quality Criteria - 56 FR 223,58418 (Nov., 1991), "Amendments to the Water Quality Standards Regulation; Compliance with  
 CWA Section 303 (c)(2)(B); Proposed Rule" - Washington D.C.  
 State Drinking Water Standards - The Bureau of National Affairs, Inc. (BNA), CD-ROMS, August 1994



### 3.6.8.3 Streamlined Risk Assessment

A streamlined risk assessment was conducted for current and future land uses at AREE 10. Risks were calculated only for the soil ingestion pathway. As shown in Table 3-34, noncancer HIs did not exceed 1 and cancer risks did not exceed  $1 \times 10^{-4}$  for either the station or the construction worker. Under a residential land use scenario, the noncancer HIs were below 1 and the cancer risks were below  $1 \times 10^{-4}$  for both the child and adult receptors.

**Table 3-34. Risk Characterization Summary for Soil Ingestion at the Former Photographic Wastewater Lagoon (AREE 10)**

Current Land Use				Future Land Use			
Noncancer HI		Cancer Risk		Noncancer HI		Cancer Risk	
Station Worker	Construction Worker	Station Worker	Construction Worker	Resident Child	Resident Adult	Resident Child	Resident Adult
0.07	0.3	2E-06	1E-06	0.9	0.1	6E-06	3E-06

### 3.6.8.4 Site Assessment

The maximum concentration of metals in the lagoon soils did not exceed the adjusted residential soil RBCs with the exception of aluminum, beryllium, and iron, which were below background concentrations. Contaminants related to the photographic sludges were not detected in the soils above background levels. The results indicate that most of the contaminated sediments were removed from the former lagoon during dredging activities that occurred in 1968. According to the streamlined risk assessment, risks do not exceed EPA target levels for soil ingestion under the current and future land use scenarios. Therefore, no further activities are recommended for the soils at the Former Photographic Wastewater Lagoon. However, EPA has requested additional soil samples to further characterize this AREE.

Metals were present in the groundwater at concentrations that exceeded MCLs and tap water RBCs. These metals are not necessarily from the former lagoon, but may be from another upgradient source (e.g., the Former STP sludge piles). Further activities are recommended to investigate the source of the groundwater contamination.

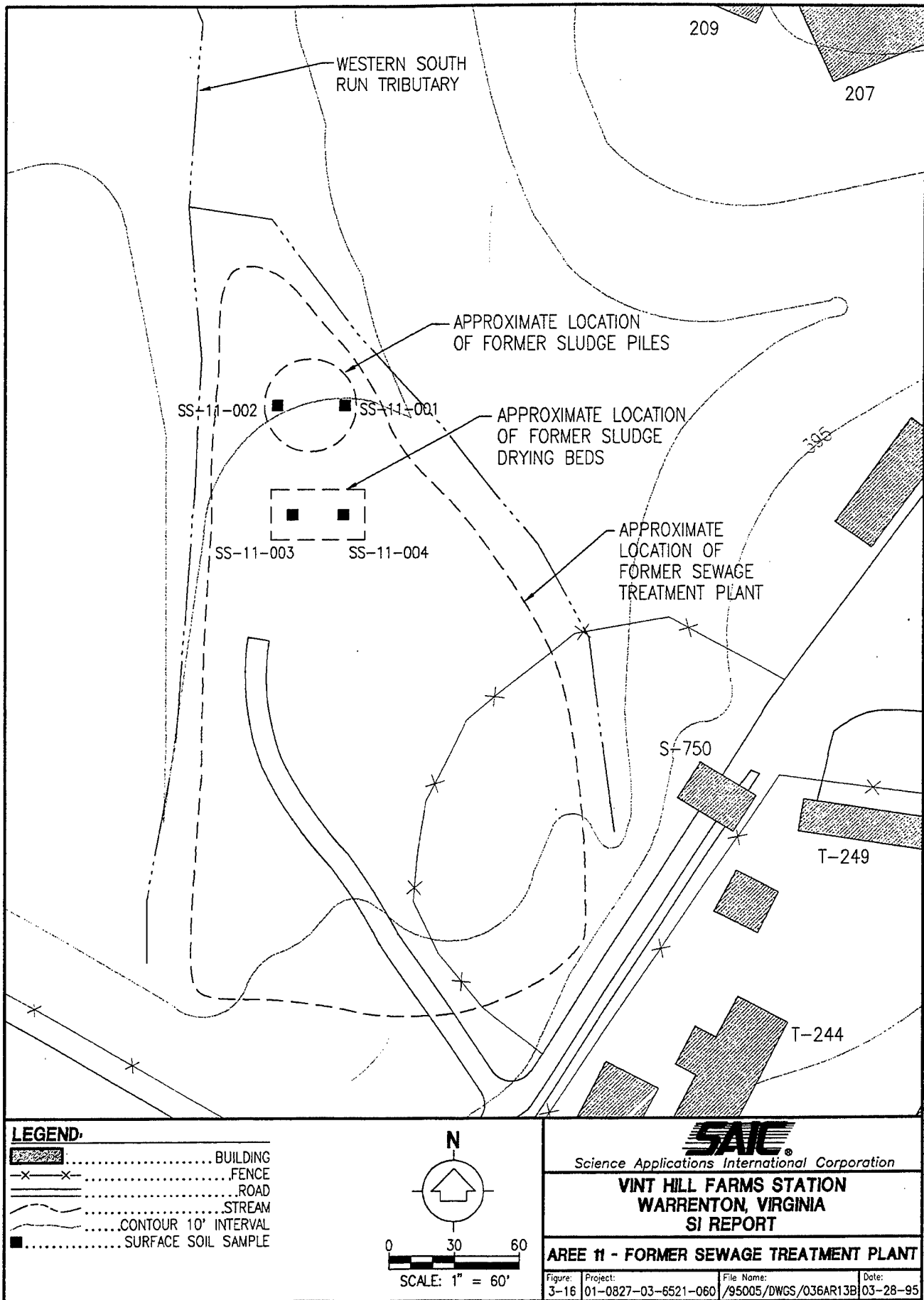
### **3.6.9 AREE 11 - Former Sewage Treatment Plant**

The Former STP was used from 1948 to 1981 to treat wastewaters from VHFS activities, including industrial wastewaters from photographic, painting, laboratory, vehicle washing, and metal etching operations. The sludges from the treatment process were drained on drying beds and then stored in piles near the western South Run tributary. Sampling at this AREE consisted of collecting two surface soil samples in the area of the drying beds and two surface soil samples in the area of the sludge piles. Figure 3-16 shows the locations of the surface soil samples at the Former STP. The target compounds at this AREE were SVOCs, cyanide, and total metals.

#### **3.6.9.1 Surface Soil Sample Results**

The results of the laboratory analyses for the Former STP are provided in Appendix J. Table 3-35 provides the results and residential soil RBCs for those contaminants that were detected above the CRL. Seven metals (mercury, arsenic, aluminum, beryllium, iron, silver, and vanadium) were detected above their adjusted residential soil RBCs. As shown in Table 3-36, the concentrations of aluminum, beryllium, iron, and vanadium are below background concentrations according to the UTL and t-tests, whereas the concentrations of mercury and silver are above background concentrations according to the UTL and t-tests. The concentrations of arsenic exceeded background because arsenic was not detected in the background soils. Concentrations of metals were highest in the drying bed area (SS-11-003 and SS-11-004). In addition, five SVOCs (pyrene, phenanthrene, benzo[a]anthracene, chrysene, and fluoranthene) were detected at low concentrations in each of the four surface soil samples. No cyanide was detected in any of the samples.

The concentrations of metals and SVOCs present in the surface soils are typical of sewage sludge contamination. The relatively uniform concentrations in each sample indicates that the sludge was essentially homogeneous and was spread evenly within the drying beds and at the sludge pile.



**Table 3-35. Data Summary Table: Soil - Former Sewage Treatment Plant (AREE 11)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SS-11-001	SS-11-002	SS-11-003	SS-11-004	Residential RBCs (EPA 1996)	Adjusted RBCs
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01		
Site Type	SURF	SURF	SURF	SURF		
Collection Date	11/4/94	11/4/94	11/4/94	11/4/94		
Depth (ft)	0	0	0	0		

<b>METALS/SOIL/CVAA (Y9) (ug/g)</b>					
Laboratory ID Number	UB06157	UB06158	UB06159	UB06160	
Parameter	Units	CRL	Units	CRL	Units
Mercury	ug/g	0.05	10**	56**	0.174**
					0.144**
					23
					3.3

<b>METALS/SOIL/GFAA (B9, JD20, JD21) (ug/g)</b>					
Laboratory ID Number	UB06157	UB06158	UB06159	UB06160	
Parameter	Units	CRL	Units	CRL	Units
Arsenic	ug/g	2.5	LT	2.5**	4.31**
Selenium	ug/g	0.449	LT	0.449**	0.43cd23n
Lead	ug/g	0.467	72**	47**	390
					N/A

<b>METALS/SOIL/ICP (JS12) (ug/g)</b>					
Laboratory ID Number	UB06157	UB06158	UB06159	UB06160	
Parameter	Units	CRL	Units	CRL	Units
Aluminum	ug/g	11.2	23900**	30800**	30700**
Barium	ug/g	3.29	212**	94.9**	125**
Beryllium	ug/g	0.427	0.822**	1.02**	1.18**
Calcium	ug/g	25.3	4460**	5150**	4260**
Cadmium	ug/g	1.2	1.2**	1.2**	1.2**
Cobalt	ug/g	2.5	14.7**	28.4**	32.5**
Chromium	ug/g	1.04	29**	37.1**	36.8**
Copper	ug/g	2.84	65.4**	60.5**	40.9**
Iron	ug/g	6.66	34100**	77000**	81000**
Potassium	ug/g	131	1250**	1210**	1010**
Magnesium	ug/g	10.1	2230**	3680**	2720**
Manganese	ug/g	9.87	484**	786**	1000**
Silver	ug/g	0.803	64.5**	2.16**	0.803**
Sodium	ug/g	38.7	153**	266**	144**
Nickel	ug/g	2.74	10.8**	18.7**	15.1**
Vanadium	ug/g	1.14	75.5**	203**	207**
Zinc	ug/g	2.34	265**	116**	118**
					79
					56
					3290
					78000
					5500
					0.15cd390n
					N/A
					78
					4700
					390
					3100
					23000
					N/A
					N/A
					10950
					390
					N/A
					1600
					550
					23000

**Table 3-35. Data Summary Table: Soil - Former Sewage Treatment Plant (AREE 11)**  
**Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	SS-11-001	SS-11-002	SS-11-003	SS-11-004	Residential RBCs (EPA 1996)	Adjusted RBCs
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01		
Site Type	SURF	SURF	SURF	SURF		
Collection Date	11/4/94	11/4/94	11/4/94	11/4/94		
Depth (ft)	0	0	0	0		

<b>SEMIVOLATILES/SOIL/GCMS (LM25) (ug/g)</b>		<b>UB06157</b>		<b>UB06158</b>		<b>UB06159</b>		<b>UB06160</b>	
Parameter	Units	CRL							
Benzo(a)anthracene	ug/g	0.041	N	0.12**	N	0.18**	N	0.19**	N
Chrysene	ug/g	0.032	N	0.16**	N	0.16**	N	0.17**	N
Fluoranthene	ug/g	0.032	N	0.098**	N	0.16**	N	0.15**	N
Phenanthrene	ug/g	0.032	N	0.098**	N	0.13**	N	0.29**	N
Pyrene	ug/g	0.083	N	0.083**	N	0.26**	N	0.29**	N
TICs	ug/g		11 (8.5)	10 (7.4)		9 (4.8)		9 (8.4)	N/A

Footnotes:  
 \* - Data collected from chemical transfer file (Phase I)  
 \*\* - Data collected from USAEC Pyramid system (Phase III)  
 \*\*\* - RBC for pyrene, a chemically-similar compound.  
 CRL - Certified reporting limit  
 ID - Identification  
 N/A - Not applicable  
 QC - Quality control  
 TICs - Tentatively Identified Compound: number of TICs (total value)  
 o- Carcinogenic effects.  
 n- Noncarcinogenic effects.  
 Boolean Codes  
 LT - Less than the certified reporting limit / method detection level  
 Data Qualifiers  
 N - The high-spike recovery is low.

**Table 3-36. Background Soil Comparison-Former Sewage Treatment Plant (AREE 11)  
Vint Hill Farms Station, Warrenton, Virginia**

Substance	AREE 11 SOIL					Differs from Background?	
	P,t,s	P,t,p	P,m-w	UTL (ppm)	% > UTL	Central Tendency	Upper Tail
						(t-test, MW test)	(UTL test)
Aluminum	0.148	0.120		60600.00	0%	no	no
Arsenic	-	-	-	-	-	yes; NDB	yes; NDB
Barium	-	-	-	-	-	-	-
Beryllium	0.696	0.685		5.10	0%	no	no
Cadmium	-	-	-	-	-	-	-
Calcium	-	-	-	-	-	-	-
Chromium	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-
Copper	-	-	-	-	-	-	-
Iron	-	-	0.386	180000.00	0%	no	no
Lead	-	-	-	-	-	-	-
Magnesium	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-
Mercury			0.018	0.07	100%	yes	yes
Nickel	-	-	-	-	-	-	-
Potassium	-	-	-	-	-	-	-
Selenium	-	-	-	-	-	-	-
Silver	-	-	-	-	-	yes;NDB	yes;NDB
Sodium	-	-	-	-	-	-	-
Thallium	-	-	-	-	-	-	-
Vanadium			0.564	531.00	0%	no	no
Zinc	-	-	-	-	-	-	-

**Notes:**

P,t,s - t-test type I error probability assuming separate (or unequal) variances

P,t,p - t-test type I error probability assuming pooled (or equal) variances

P,m-w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples

### **3.6.9.2 Site Assessment**

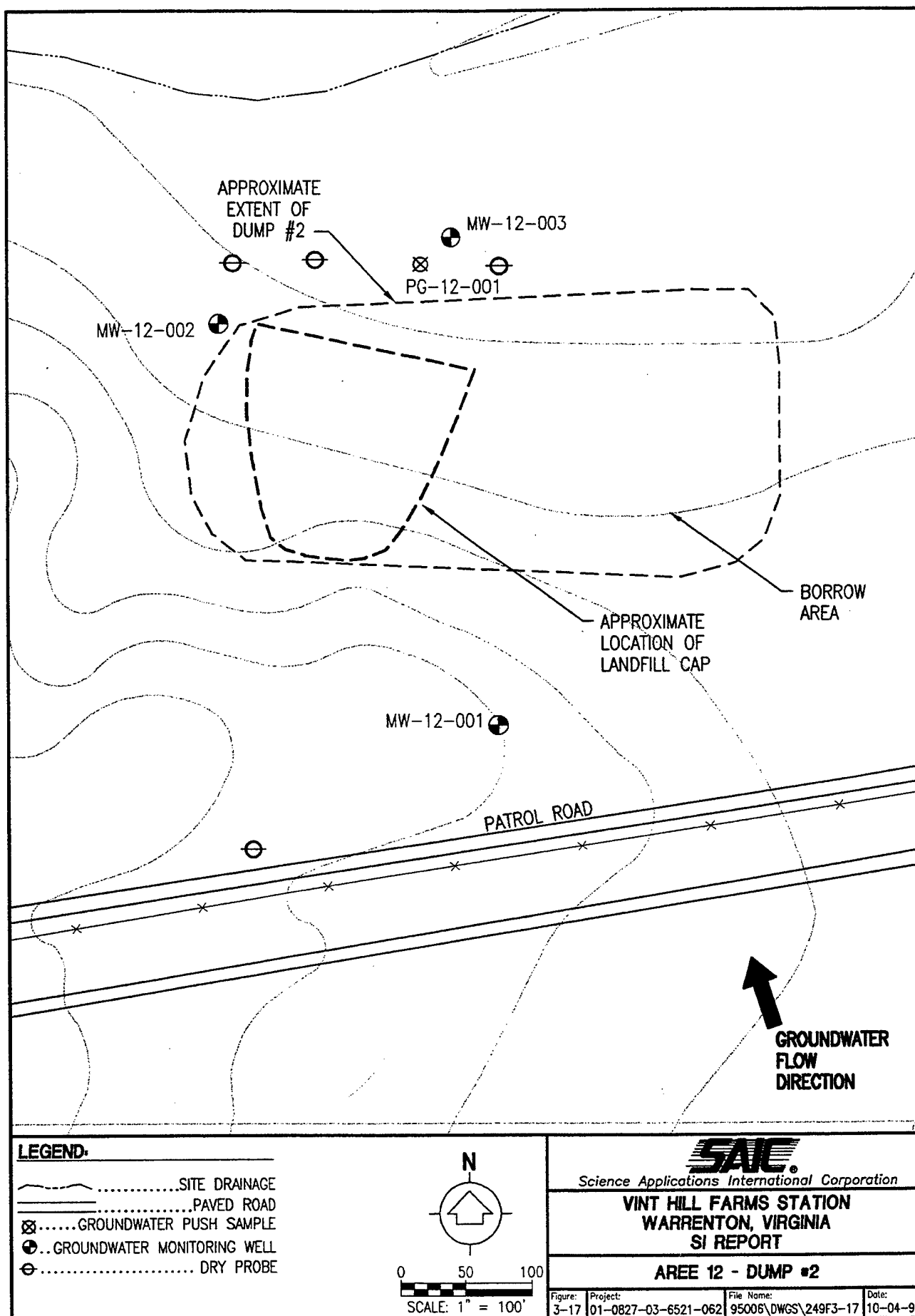
Seven metals above residential soil RBCs (of which three metals also are above background concentrations) were detected in samples collected from the four surface soil borings. In addition, five SVOCs indicative of sewage sludge were detected in the surface soils. Based on these results, further activities are recommended for the Former STP to determine the extent of contamination in the soils, if the adjacent tributary has been influenced through migration of contaminants from the Former STP, and if the sludge piles are the source of the groundwater contamination at GW05W (see Section 3.6.8.2).

### **3.6.10 AREE 12 - Dump #2**

Dump #2 was used as a construction debris disposal area from 1958 to 1985. Initial sampling at this AREE consisted of installing groundwater probes downgradient from the landfill area and collecting groundwater samples. However, due to the presence of consolidated material, only one of the probes (PG-12-001) contained groundwater. This probe was located downgradient from the dump. Followup sampling at this AREE consisted of installing three monitoring wells, one upgradient and two downgradient. Figure 3-17 shows the location of the groundwater probes and wells at Dump #2. The target compounds at this AREE were VOCs, SVOCs, and metals, but only the VOC sample could be obtained in the probe due to the extremely low recharge rate.

#### **3.6.10.1 Groundwater Sample Results**

The results of the laboratory analyses for Dump #2 are provided in Appendix J. Table 3-37 provides the results for those contaminants detected above the CRL. Three metals (beryllium, iron, and manganese) were detected above the adjusted tap water RBCs. However, manganese and iron were detected above RBCs in the upgradient well but not the downgradient wells. This may be attributed to the fact that the upgradient well was a very slow recharger and could not be developed sufficiently to eliminate all fine particulates in the surrounding area. When the sample was acidified, the particulate iron and manganese dissolved into solution and gave an artificially high result. The concentrations of beryllium, iron, and manganese did not exceed drinking water MCLs. No VOCs were detected in the groundwater with the exception





**Table 3-37. Data Summary Table: Groundwater - Dump #2 (AREE 12)  
Vint Hill Farms Station, Warrenton, Virginia**

Site ID	MW-12-001	MW-12-002	MW-12-003	PG-12-001	Residential Tap Water RBCs (EPA 1996)	Adjusted Tap Water RBCs
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01		
Site Type	WELL	WELL	WELL	WELL		
Collection Date	6/14/95	6/14/95	6/14/95	11/18/94		
Depth (ft)	38.43	18.94	41.96	13.27		
Associated Field QC Sample - Site ID						
Associated Field QC Sample - Field Sample No.						
Associated Field QC Sample - Site ID						
Associated Field QC Sample - Field Sample No.						

<b>METALS/WATER/ICP (SS12, 6010) (ug/L)</b>					
Laboratory ID Number	UC01846	UC01849	UC01845	N/A	
Parameter	Units	CRL			
Aluminum	ug/L	112			
Barium	ug/L	2.82	112*	214*	37000
Beryllium	ug/L	1.12	388*	440*	2600
Calcium	ug/L	105	2.04*	1.76*	0.016c/182n
Iron	ug/L	77.5	60000*	52600*	N/A
Potassium	ug/L	1240	77.5*	275*	11000
Magnesium	ug/L	135	1840*	1240*	N/A
Manganese	ug/L	9.67	10300*	11300*	N/A
Sodium	ug/L	279	13.2*	14.8*	180
Zinc	ug/L	18	5380*	8550*	N/A
			28.5*	19.7*	11000

<b>VOLATILES/WATER/GCMS (UM21) (ug/L)</b>					
Laboratory ID Number	UC01846	UC01849	UC01845	UB06361	
Parameter	Units	CRL			
1,2-Dichloroethane	ug/L	1	1*	1*	1**
Acetone	ug/L	8	8*	8*	23** A
Methylene Chloride	ug/L	1	1*	1*	1**

<b>POLYNUCLEAR AROMATIC HYDROCARBONS/WATER (B310) (ug/L)</b>					
Laboratory ID Number	UC01846	UC01849	UC01845	N/A	
Parameter	Units	CRL			
Benzo(k)fluoranthene	ug/L	0.019	0.0464* G	0.0366* G	0.92

Footnotes:

- \* - Data collected from chemical transfer file (Phase I)
- \*\* - Data collected from USAEC Pyramid system (Phase III)
- CRL - Certified reporting limit
- ID - Identification
- N/A - Not applicable
- N/F - Analysis requested, not yet received
- QC - Quality control
- TICs - Tentatively Identified Compound: number of TICs (total value)
- Boolean Codes
- LT - Less than the certified reporting limit / method detection level

Flagging Codes:

- G - Analyte found in the rinse blank as well as the sample.
- A - Analyte found in the trip blank as well as the sample.

For analytes flagged with "A," "G," "B," "U," or "I," half the detected value was compared with the RBC.

of acetone at 23 µg/L. However, according to the data quality assessment, the presence of acetone is highly suspect and should be considered a false positive.

### 3.6.10.2 Streamlined Risk Assessment

At AREE 12, a streamlined risk assessment was conducted for the groundwater ingestion pathway. Only resident receptors are assumed to be exposed to groundwater. As shown in Table 3-38, noncancer HIs did not exceed 1 and cancer risks did not exceed  $1 \times 10^{-4}$  for either the child or adult receptors.

**Table 3-38. Risk Characterization Summary  
for Groundwater Ingestion at Dump #2 (AREE 12)**

Future Land Use			
Noncancer HI		Cancer Risk	
Resident Child	Resident Adult	Resident Child	Resident Adult
1	0.6	5E-05	1E-04

### 3.6.10.3 Site Assessment

Beryllium, iron, and manganese were detected above their adjusted tap water RBCs (0.016 µg/L; 2,750 µg/L; and 45 µg/L, respectively). Beryllium was detected below its MCL of 4 µg/L. According to the streamlined risk assessment, risks do not exceed EPA target levels for human receptors who may use the groundwater as a drinking water source in the future. Therefore, no further action is recommended for Dump #2. However, EPA has requested additional soil and groundwater samples to further characterize this AREE.

### 3.6.11 AREE 13 - Sludge Disposal Area

The Sludge Disposal Area was used during the 1980s to store sludges from the STP (AREE 2) and the Former STP (AREE 11) and sand filter sludge and sandblasting waste from the electrical equipment facility. In June 1992, the area was excavated to remove all material and closed. Sampling at this AREE consisted of drilling and sampling four soil borings within the disposal area. Because the original top layer of soil was disturbed by landscaping and

reseeding after the 1992 sludge removal, the soil sample was collected at the 1- to 3-foot interval. Figure 3-18 shows the locations of the soil borings at the Sludge Disposal Area. The target compounds at this AREE were cyanide and total metals.

### 3.6.11.1 Soil Boring Results

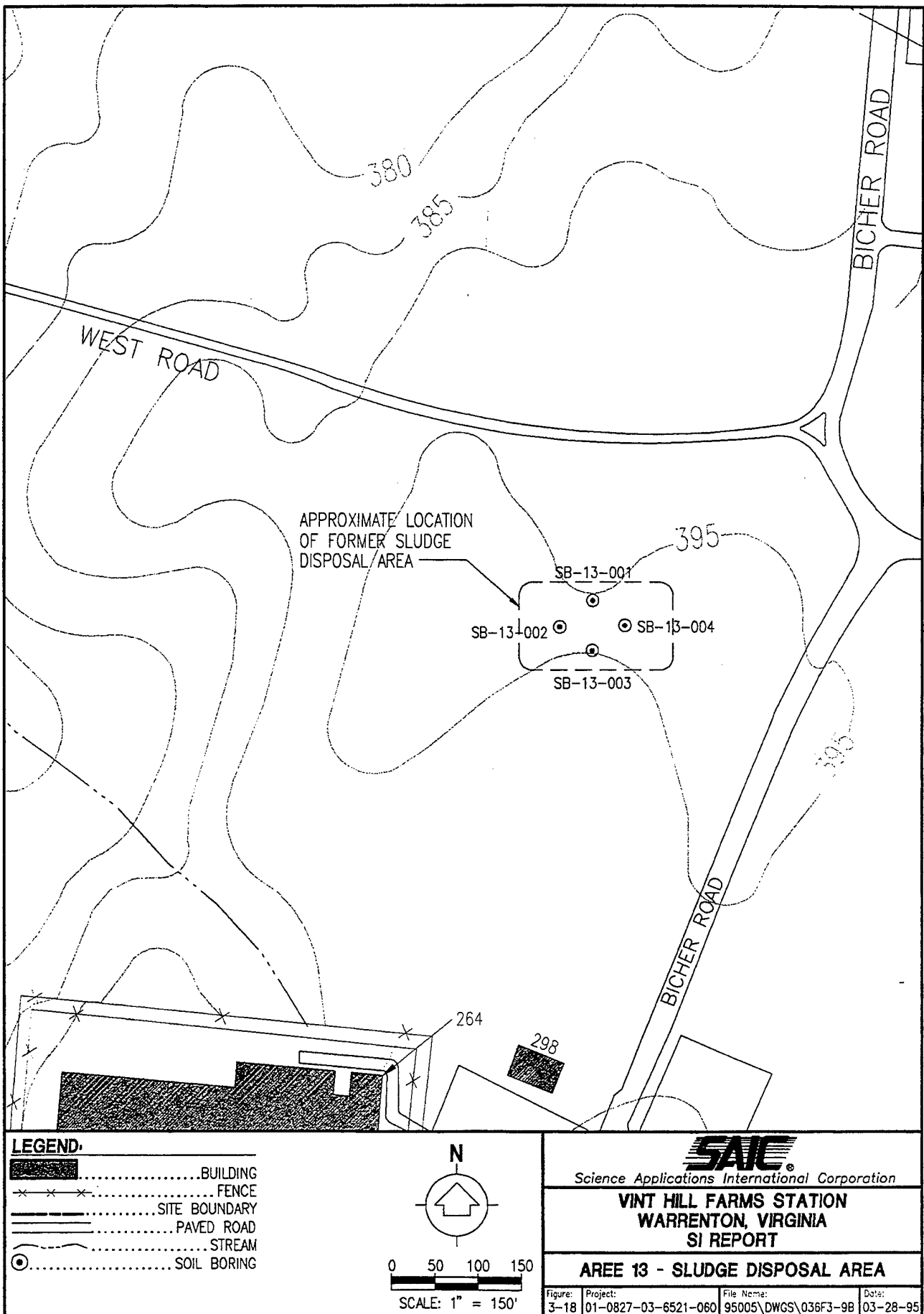
The results of the laboratory analyses for the Sludge Disposal Area are provided in Appendix J. Table 3-39 provides the results and residential soil RBCs for those contaminants detected above the CRL. Four metals (aluminum, beryllium, iron, and vanadium) were detected above their adjusted residential soil RBCs. As shown in Table 3-40, the concentrations of beryllium and vanadium did not exceed background concentrations according to the UTL and t-test. Aluminum and iron were present at concentrations that exceeded background concentrations according to the UTL test, but not the t-test. No cyanide was detected in any of the soil samples.

### 3.6.11.2 Streamlined Risk Assessment

A streamlined risk assessment was conducted for current and future land uses at AREE 13. Risks were calculated only for the soil ingestion pathway. As shown in Table 3-41, noncancer HIs did not exceed 1 and cancer risks did not exceed  $1 \times 10^{-4}$  for either the station or the construction worker. Under a residential land use scenario, noncancer HIs did not exceed 1 and cancer risks did not exceed  $1 \times 10^{-4}$  for either the child or adult receptor.

**Table 3-41. Risk Characterization Summary  
for Soil Ingestion at the Sludge Disposal Area (AREE 13)**

Current Land Use				Future Land Use			
Noncancer HI		Cancer Risk		Noncancer HI		Cancer Risk	
Station Worker	Construction Worker	Station Worker	Construction Worker	Resident Child	Resident Adult	Resident Child	Resident Adult
0.08	0.4	3E-06	1E-06	1	0.1	8E-06	4E-06



**Table 3-39. Data Summary Table: Soil - Sludge Disposal Area (AREE 13)  
Vint Hill Farms Station, Warrenton, Virginia**

Site ID	Field Sample Number	SB-13-001	SB-13-001	SB-13-001	SB-13-002	SB-13-003	SB-13-004	Residential RBCs (EPA 1996)	Adjusted RBCs
Site Type	SAIC01	SAIC02	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01		
Collection Date	GSDA	GSDA	GSDA	GSDA	GSDA	GSDA	GSDA		
Depth (ft)	11/4/94	11/4/94	11/4/94	11/4/94	11/4/94	11/4/94	11/4/94		
	1	1	1	1	1	1	1		
<b>METALS/SOIL/CVAA (Y) (ug/g)</b>									
Laboratory ID Number	UB06152	UB06153	UB06154	UB06155	UB06156				
Parameter	Units	CRL	LT	0.05** D	LT	0.05**	0.0623**	23	
Mercury	ug/g	0.05	0.113**						
<b>METALS/SOIL/GFAA (B9, JB20, JB21) (ug/g)</b>									
Laboratory ID Number	UB06152	UB06153	UB06154	UB06155	UB06156				
Parameter	Units	CRL	LT	0.05** D	LT	0.05**	0.0623**	23	
Lead	ug/g	0.467	6.05**	5.64** D	7.5**	7.41**	240**	N/A	
<b>METALS/SOIL/ICP (JS12) (ug/g)</b>									
Laboratory ID Number	UB06152	UB06153	UB06154	UB06155	UB06156				
Parameter	Units	CRL	LT	0.05** D	LT	0.05**	0.0623**	23	
Aluminum	ug/g	11.2	60700**	54600** D	53300**	68400**	73100**	78000	26000
Barium	ug/g	3.29	52.8**	60.3** D	95.4**	71.7**	69**	5500	
Beryllium	ug/g	0.427	1.08**	1.04** D	1.3**	1.22**	1.72**	0.15c/390n	
Calcium	ug/g	25.3	4070**	4210** D	5050**	3180**	1390**	N/A	
Cobalt	ug/g	2.5	36.7**	35.3** D	34.9**	48.3**	48.4**	4700	
Chromium	ug/g	1.04	27.7**	19.5** D	19.2**	28.9**	28.9**	390	
Copper	ug/g	2.84	25.5**	28.7** D	29**	25.9**	35.8**	3100	
Iron	ug/g	6.68	120000**	75200** D	84000**	95000**	230000**	23000	7670
Potassium	ug/g	131	368**	272** D	263**	358**	396**	N/A	
Magnesium	ug/g	10.1	4730**	4740** D	6840**	4070**	3140**	N/A	
Manganese	ug/g	9.87	98**	105** D	89**	64.3**	541**	10950	
Sodium	ug/g	38.7	103**	112** D	989**	88.3**	82.8**	N/A	
Nickel	ug/g	2.74	13.5**	13.9** D	18.3**	18.6**	12.1**	1600	
Vanadium	ug/g	1.14	233**	221** D	227**	258**	317**	550	183
Zinc	ug/g	2.34	94.3**	74.7** D	89.4**	102**	90.3**	23000	

Footnotes:  
 \* - Data collected from chemical transfer file (Phase I)  
 \*\* - Data collected from USAEC Pyramid system (Phase III)  
 CRL - Certified reporting limit  
 ID - Identification  
 N/A - Not applicable  
 QC - Quality control  
 TICs - Tentatively Identified Compound: number of TICs (total value)  
 Boolean Codes  
 LT - Less than the certified reporting limit / method detection level  
 Flagging Codes  
 D - Duplicate analysis.

**Table 3-40. Background Soil Comparison-Sludge Disposal Area (AREE 13)  
Vint Hill Farms Station, Warrenton, Virginia**

Substance	AREE 13 SOIL					Differs from Background?	
	P,t,s	P,t,p	P,m-w	UTL (ppm)	% > UTL	Central Tendency	Upper Tail
						(t-test, MW test)	(UTL test)
Aluminum	0.073	0.050		60600.00	75%	no	yes
Arsenic	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-
Beryllium	0.566	0.546		5.10	0%	no	no
Cadmium	-	-	-	-	-	-	-
Calcium	-	-	-	-	-	-	-
Chromium	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-
Copper	-	-	-	-	-	-	-
Iron	0.476	0.474	-	180000.00	25%	no	yes
Lead	-	-	-	-	-	-	-
Magnesium	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-
Mercury	-	-	-	-	-	-	-
Nickel	-	-	-	-	-	-	-
Potassium	-	-	-	-	-	-	-
Selenium	-	-	-	-	-	-	-
Silver	-	-	-	-	-	-	-
Sodium	-	-	-	-	-	-	-
Thallium	-	-	-	-	-	-	-
Vanadium	0.710	0.699		531.00	0%	no	no
Zinc	-	-	-	-	-	-	-

**Notes:**

P,t,s - t-test type I error probability assuming separate (or unequal) variances

P,t,p - t-test type I error probability assuming pooled (or equal) variances

P,m-w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples

### 3.6.11.3 Site Assessment

Soil samples from the four borings did not exceed residential soil RBCs and background concentrations with the exception of aluminum and iron. According to the streamlined risk assessment, risks do not exceed EPA target levels under the current and future land uses. Therefore, no further activities are recommended for the soils at the Sludge Disposal Area. However, EPA has requested additional soil samples to further characterize this AREE.

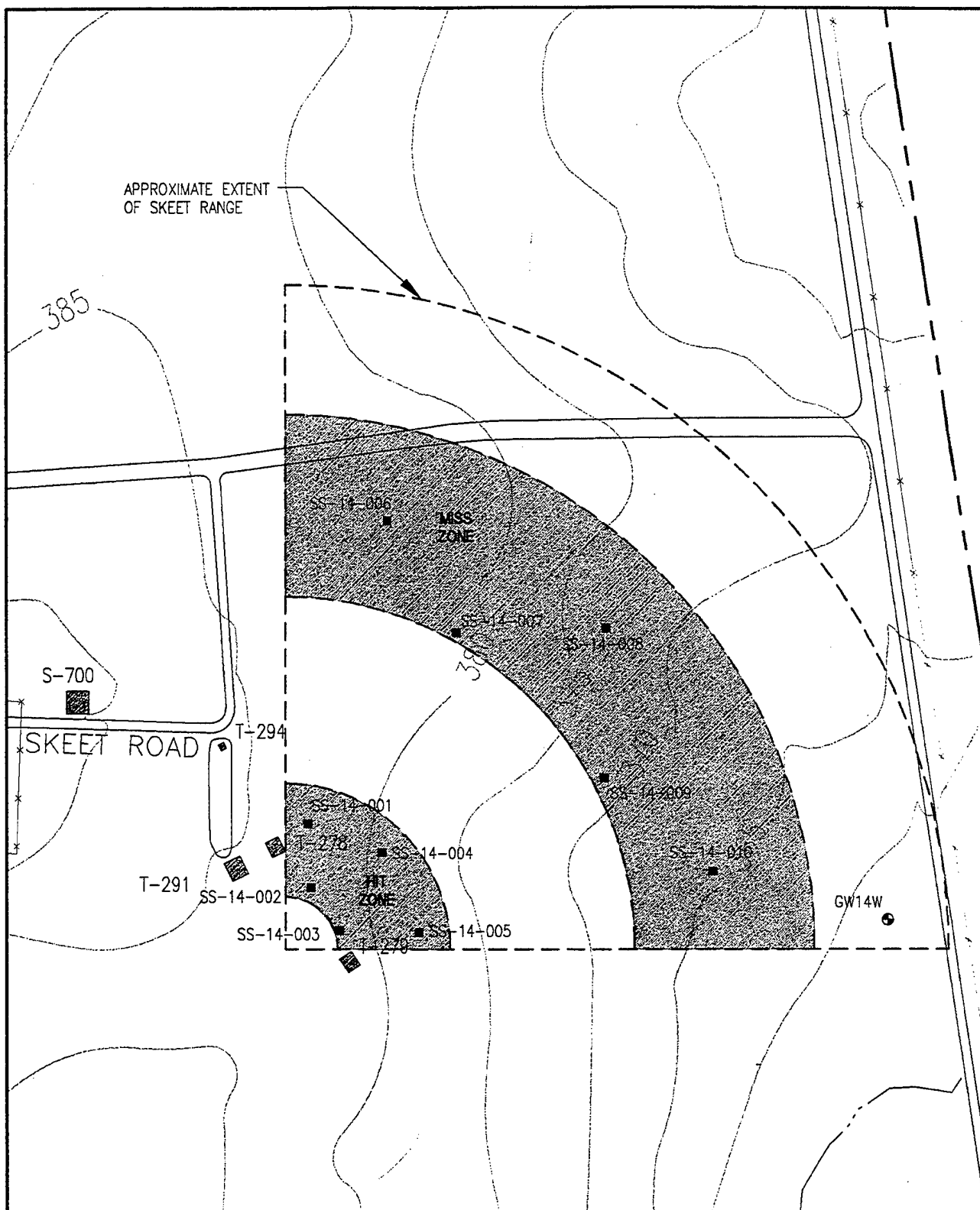
### 3.6.12 AREE 14 - Skeet Range

The Skeet Range has been used on weekends since 1961 for shotgun target practice. The spent ammunition (i.e., lead and steel shotgun pellets) is spread out over the range and is not recovered. Sampling at this AREE consisted of collecting 10 surface soil samples within the firing fan and 1 groundwater sample from the existing monitoring well located downgradient from the area. Figure 3-19 shows the locations of the surface soil borings and existing monitoring well at the Skeet Range. The target compounds at this AREE were total lead, organic lead, and soil quality parameters (reduction-oxidation [redox] potential, pH, total organic carbon [toc], and grain size).

#### 3.6.12.1 Surface Soil Sample Results

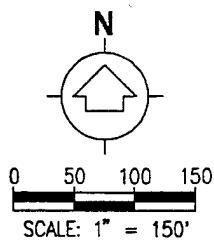
The results of the laboratory analyses for AREE 14 are provided in Appendix J. Table 3-42 provides the results for lead concentrations detected above the CRL. As shown in Table 3-43, lead exceeded background concentrations at all 10 soil samples according to both the t-test and the UTL test. The concentrations in the hit zone ranged from 61 to 270  $\mu\text{g/g}$  and in the miss zone from 26 to 940  $\mu\text{g/g}$ . The highest concentrations were detected in the miss zone at SS-14-006 (940  $\mu\text{g/g}$ ), SS-14-008 (650  $\mu\text{g/g}$ ), and SS-14-010 (370  $\mu\text{g/g}$ ). The EPA screening level for lead in residential soils of 400  $\mu\text{g/g}$  was exceeded by 2 of the 10 samples. Organic lead was not detected in any of the samples.

The results of the soil quality parameters are shown in Table 3-42 and in Appendix H. The redox potential ranged from 490 millivolts (mV) at SS-14-001 to 580 mV at SS-14-006. These relatively high redox potentials indicate that an oxidizing environment is present in the



**LEGEND:**

- .....BUILDING
- .....FENCE
- .....SITE BOUNDARY
- .....PAVED ROAD
- .....STREAM
- .....SURFACE SOIL SAMPLE
- .....GROUNDWATER MONITORING WELL



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**AREA 14 - SKEET RANGE**

Figure: 3-19	Project: 01-0827-03-6521-060	File Name: 95005\DWGS\036F310B	Date: 03-28-95
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**Table 3-42. Data Summary Table: Soil - Skeet Range (AREE 14)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SS-14-001	SS-14-002	SS-14-002	SS-14-003
Field Sample Number	SAIC01	SAIC01	SAIC02	SAIC01
Site Type	SURF	SURF	SURF	SURF
Collection Date	11/8/94	11/8/94	11/8/94	11/8/94
Depth (ft)	0	0	0	0

**TOTAL LEAD/SOIL (JD21) (ug/g)**

Units 10000, 10000, 10000			
Laboratory ID Number	UB06185	UB06186	UB06188
Parameter			
Total Lead	61**	170**	270**
	60** D		

## SOIL PARAMETERS

Parameter	Units	ORL	
Total Organic Carbon	ug/g	1000	
pH			
Redox Potential	mV		
		20100*	N/A
		7.03*	N/A
		490*	N/A
		59300*	N/A
		6.98*	N/A
		534*	N/A
		15400*	N/A

**Table 3-42. Data Summary Table: Soil - Skeet Range (AREE 14)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	SS-14-004	SS-14-005	SS-14-006	SS-14-007	SS-14-008
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01
Site Type	SURF	SURF	SURF	SURF	SURF
Collection Date	11/8/94	11/8/94	11/9/94	11/9/94	11/9/94
Depth (ft)	0	0	0	0	0

<b>TOTAL LEAD/SOIL (JD21) (ug/g)</b>			
Laboratory ID Number	UB06184	UB06189	UB06203
Parameter	Units	CRL	UB06204
Total Lead	ug/g	0.467	97**
		96**	940**
			26**
			650**

<b>SOIL PARAMETERS</b>			
Parameter	Units	CRL	
Total Organic Carbon	ug/g	1000	16000*
pH			6.4*
Redox Potential	mV		563*
			26500*
			7.20*
			492*
			21600*
			5.93*
			580*
			20200*
			6.21*
			557*
			22000*
			6.16*
			531*

Table 3-42. Data Summary Table: Soil - Skeet Range (AREE 14)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)

Site ID	SS-14-009	SS-14-010
Field Sample Number	SAIC01	SAIC01
Site Type	SURF	SURF
Collection Date	11/9/94	11/9/94
Depth (ft)	0	0

<b>TOTAL LEAD/SOIL (JD21) (ug/g)</b>		
Laboratory ID Number	UB06205	UB06207
Parameter	Units	CRL
Total Lead	ug/g	0.467
		200**
		370**

<b>SOIL PARAMETERS</b>		
Parameter	Units	CRL
Total Organic Carbon	ug/g	1000
pH		22400*
Redox Potential	mV	6.19*
		541*
		11700*
		6.14*
		549*

Footnotes:  
 \* - Data collected from chemical transfer file (Phase I)  
 \*\* - Data collected from USAEC Pyramid system (Phase III)  
 CRL - Certified reporting limit  
 ID - Identification  
 N/A - Not applicable  
 QC - Quality control  
 TICs - Tentatively Identified Compound: number of TICs (total value)  
 Flagging Codes  
 D - Duplicate analysis.

**Table 3-43. Background Soil Comparison-Skeet Range (AREE 14)  
Vint Hill Farms Station, Warrenton, Virginia**

Substance	AREE 14 SOIL					Differs from Background?	
	P,t,s	P,t,p	P,m-w	UTL (ppm)	% > UTL	Central Tendency	Upper Tail
						(t-test, MW test)	(UTL test)
Aluminum	-	-	-	-	-	-	-
Arsenic	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-
Beryllium	-	-	-	-	-	-	-
Cadmium	-	-	-	-	-	-	-
Calcium	-	-	-	-	-	-	-
Chromium	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-
Copper	-	-	-	-	-	-	-
Iron	-	-	-	-	-	-	-
Lead	-	-	0.005	13.00	100%	yes	yes
Magnesium	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-
Mercury	-	-	-	-	-	-	-
Nickel	-	-	-	-	-	-	-
Potassium	-	-	-	-	-	-	-
Selenium	-	-	-	-	-	-	-
Silver	-	-	-	-	-	-	-
Sodium	-	-	-	-	-	-	-
Thallium	-	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-	-
Zinc	-	-	-	-	-	-	-

**Notes:**

P,t,s - t-test type I error probability assuming separate (or unequal) variances

P,t,p - t-test type I error probability assuming pooled (or equal) variances

P,m-w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples

surface soils. In such an environment, the metallic lead will tend to become slightly mobile. The pH results ranged from 5.93 at SS-14-006 to 7.20 at SS-14-005. These pH values indicate that the surface soils are relatively neutral. Lead in neutral environments is less soluble than in acidic environments. Concentrations of toc in the soil ranged from 11,700  $\mu\text{g/g}$  at SS-14-010 to 59,300  $\mu\text{g/g}$  at SS-14-002. The grain size analysis shows that the soils found at the Skeet Range are dark to medium-brown sandy silts. These silts tend to be negatively charged and will hold the positively charged lead ions strongly, decreasing the mobility of the lead.

The lead concentrations are typical for a skeet range in which lead has been released from the pellets to the surrounding soils due to natural weathering. However, the lack of acidity and silty soils indicate that the lead has a low solubility in this environment and will tend to remain adsorbed to surface soil particles.

#### **3.6.12.2 Groundwater Sample Results**

The results of the laboratory analyses for AREE 14 are provided in Appendix J. Lead was not detected in the existing groundwater monitoring well (GW14W) above the CRL of 4.47  $\mu\text{g/L}$ . The organic lead analysis was not conducted because total lead was not detected in the initial analysis.

#### **3.6.12.3 Site Assessment**

Total lead was detected above the EPA screening level in samples collected from the surface soil borings. However, lead was not detected in the groundwater. The physical and chemical nature of the soils indicate that the lead would remain adsorbed to the surface soil particles and mobility in the environment would be decreased. Further investigations should be conducted to determine the full extent of lead contamination in the soils, the potential for migration of lead to the groundwater, and the need for remedial actions at the Skeet Range.

#### **3.6.13 AREE 16 - Firefighter Training Pit**

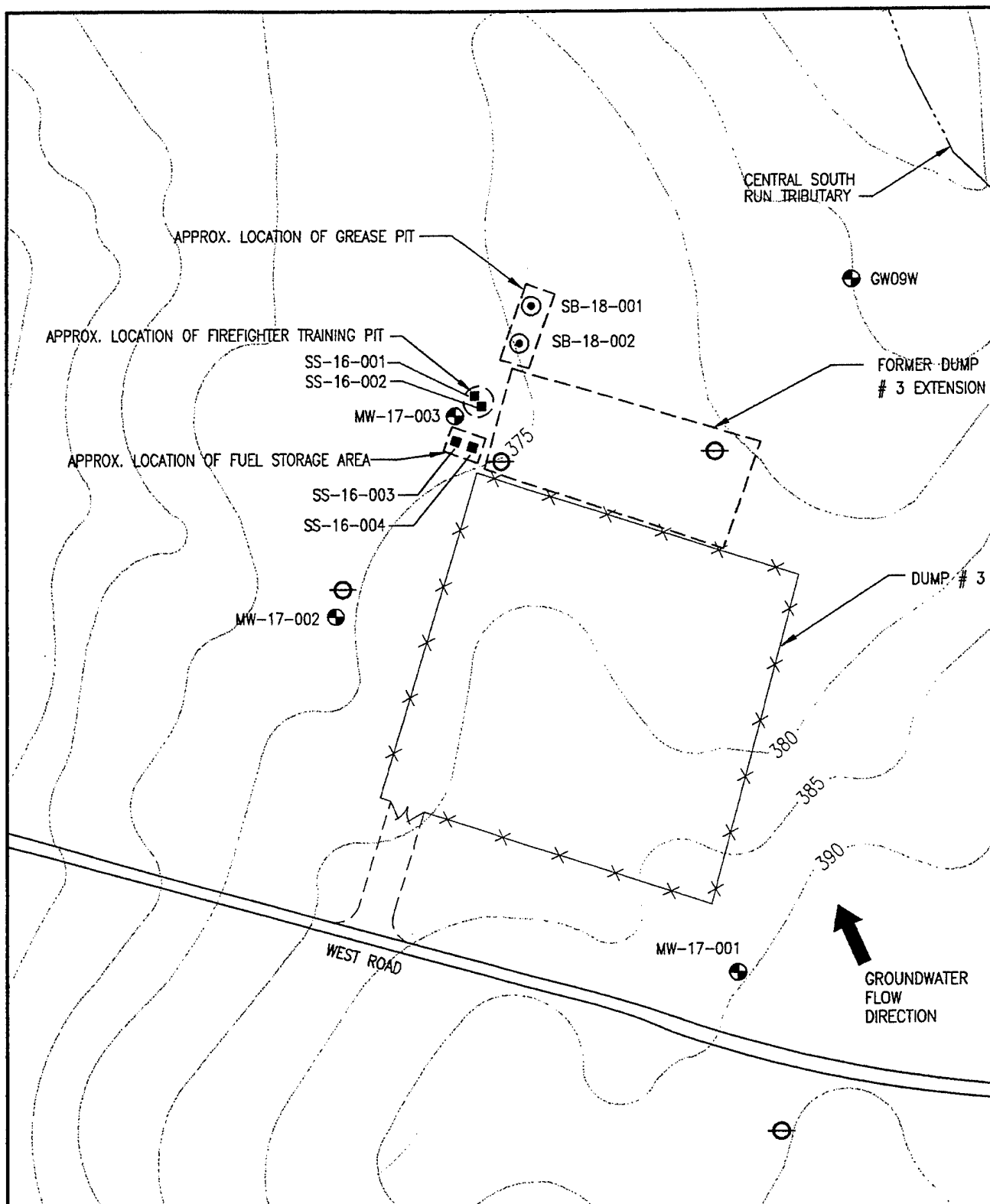
The Firefighter Training Pit was formerly used by the VHFS Fire Department for training once each month during the mid-1970s. Drums of waste oil and tanks of jet fuel were

stored on an unbermed area south of the pit. The estimated location of the Firefighter Training Pit was based on verbal accounts from VHFS employees (Hitt 1993), previous documentation from the Installation Assessment (ESE 1981), and historical aerial photographs (EPIC 1983). Various discrepancies were noted between each source of information and none was as precise as needed to make an absolute determination of the location of the pit. Sampling at this AREE consisted of collecting two surface soil samples within the pit area and two surface soil samples within the petroleum storage area. Figure 3-20 shows the locations of the surface soil borings at the Firefighter Training Pit. The target compounds at this AREE were VOCs, SVOCs, TPH, and total metals.

#### **3.6.13.1 Soil Boring Results**

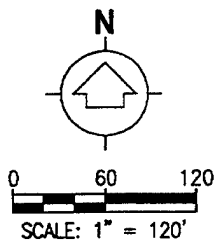
The results of the laboratory analyses for the Firefighter Training Pit are provided in Appendix J. Table 3-44 provides the results and residential soil RBCs for those compounds and analytes that were detected above the CRL. Four metals (aluminum, beryllium, iron, and manganese) were detected above their adjusted residential soil RBCs. As shown in Table 3-45, the concentrations of aluminum, beryllium, and iron did not exceed background, whereas manganese exceeded background according to both the t-test and the UTL test. One VOC (acetone) was detected in SS-16-001 at a low concentration. However, acetone was flagged with an "A" to indicate that the analyte was detected in the trip blank and its presence is considered suspect. In addition, TPH was detected at 77.8  $\mu\text{g/g}$  in the pit area and 17.4  $\mu\text{g/g}$  in the fuel storage area. No SVOCs were detected above the CRL.

The results from sampling conducted at the Firefighter Training Pit are not consistent with those normally found at the sites where firefighting activities occur. No PAHs were detected in the soils and uncharacteristically low concentrations of TPH were detected. PAHs are burning residues that typically are detected at fire training areas. In addition, significant concentrations of TPH normally are detected. Furthermore, the fire training pit could not be located precisely from the aerial photographs. Therefore, it is possible that the actual pit was not located or that the surface of the pit was originally at depths that were not sampled.



**LEGEND:**

- x — x — x — FENCE
- ===== PAVED ROAD
- ~~~~~ STREAM
- ⊙..... SOIL BORING
- ⊕..... GROUNDWATER MONITORING WELL
- ..... SURFACE SOIL SAMPLES
- ..... DRY PROBE



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**AREAS 16, 17 AND 18 - FIREFIGHTER TRAINING PIT,  
DUMP #3, AND GREASE PIT**

Figure: 3-20	Project: 01-0827-03-6521-062	File Name: 95005\DWGS\249F3-20	Date: 10-11-95
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Table 3-44. Data Summary Table: Soil - Firefighter Training Pit (AREE 16)  
Vint Hill Farms Station, Warrenton, Virginia

Site ID	SS-16-001	SS-16-001	SS-16-002	SS-16-003	SS-16-004	Residential RBCs (EPA 1996)	Adjusted RBCs
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01		
Site Type	SURF	SURF	SURF	SURF	SURF		
Collection Date	11/3/94	11/3/94	11/3/94	11/3/94	11/3/94		
Depth (ft)	0	0	0	0	0		

METALS/SOIL/CAA (V8) (ug/g)						
Laboratory ID Number	UB06140	UB06142	UB06143	UB06144		
Parameter	Units	CRL	Units	CRL	Units	CRL
Mercury	ug/g	0.05	LT	0.05**	LT	0.05**
						23

METALS/SOIL/GFAA (B9, JD20, JD21) (ug/g)						
Laboratory ID Number	UB06140	UB06141	UB06142	UB06143	UB06144	
Parameter	Units	CRL	Units	CRL	Units	CRL
Lead	ug/g	0.467	17**	16.3** D	12.6**	17.2**
						N/A

METALS/SOIL/ICP (JS12) (ug/g)						
Laboratory ID Number	UB06140	UB06141	UB06142	UB06143	UB06144	
Parameter	Units	CRL	Units	CRL	Units	CRL
Aluminum	ug/g	11.2	28800**	30300** D	33500**	33800**
Barium	ug/g	3.29	236**	252** D	170**	279**
Beryllium	ug/g	0.427	1.56**	1.67** D	1.57**	1.88**
Calcium	ug/g	25.3	781**	998** D	845**	1.15**
Cobalt	ug/g	2.5	23.0**	25.5** D	33.7**	18.1**
Chromium	ug/g	1.04	29.3**	32.3** D	42.8**	38.8**
Copper	ug/g	2.84	18.5**	32.7** D	7.34**	35.1**
Iron	ug/g	6.66	33800**	37000** D	33300**	17**
Potassium	ug/g	131	1700**	2040** D	46300**	3100
Magnesium	ug/g	10.1	3300**	3480** D	4710**	23000
Manganese	ug/g	9.87	1500**	1700** D	1590**	N/A
Sodium	ug/g	38.7	53.4**	53.4** D	808**	4170**
Nickel	ug/g	2.74	17.6**	20.3** D	1110**	3100**
Vanadium	ug/g	1.14	49.2**	54.3** D	38.7**	10950
Zinc	ug/g	2.34	111**	168** D	13.3**	N/A
					55.1**	1800
					88.5**	550
						23000

VOLATILES/SOIL/GCMS (LM23) (ug/g)						
Laboratory ID Number	UB06140	UB06141	UB06142	UB06143	UB06144	
Parameter	Units	CRL	Units	CRL	Units	CRL
Acetone	ug/g	3.3	10** A	3.3** D	3.3**	3.3**
TICs	ug/g	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
						7800
						N/A

SEMI-VOLATILES/SOIL/GCMS (LM26) (ug/g)						
Laboratory ID Number	UB06140	UB06141	UB06142	UB06143	UB06144	
Parameter	Units	CRL	Units	CRL	Units	CRL
TICs	ug/g	17 (14.0)	16 (21.8)	2 (1.4)	7 (3.7)	7 (4.2)
						N/A

TRPHYSOIL (EPA 418.1) (ug/g)						
Laboratory ID Number	UB06140	UB06141	UB06142	UB06143	UB06144	
Parameter	Units	CRL	Units	CRL	Units	CRL
Total Petroleum Hydrocarbons	ug/g	10	77.8**	30.4** D	17.4**	10**
						N/A

Footnotes:

\* - Data collected from chemical transfer file (Phase I)

\*\* - Data collected from USAEC Pyramid system (Phase II)

For analytes flagged with "A," "G," "U," or "I," half the detected value was compared with the RBC.

CRL - Certified reporting limit

ID - Identification

N/A - Not applicable

QC - Quality control

TICs - Tentatively Identified Compound: number of TICs (total value)

Boolean Codes

LT - Less than the certified reporting limit / method detection level

Flagging Codes

D - Duplicate analysis

A - Analyte found in trip blank as well as in field sample.



**Table 3-45. Background Soil Comparison-Firefighter Training Pit (AREE 16)  
Vint Hill Farms Station, Warrenton, Virginia**

Substance	AREE 16 SOIL					Differs from Background?	
	P,t,s	P,t,p	P,m-w	UTL (ppm)	% > UTL	Central Tendency (t-test, MW test)	Upper Tail (UTL test)
Aluminum	0.206	0.191		60600.00	0%	no	no
Arsenic	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-
Beryllium	0.470	0.443		1.68	0%	no	no
Cadmium	-	-	-	-	-	-	-
Calcium	-	-	-	-	-	-	-
Chromium	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-
Copper	-	-	-	-	-	-	-
Iron	0.046	0.022	-	180000.00	0%	yes	no
Lead	-	-	-	-	-	-	-
Magnesium	-	-	-	-	-	-	-
Manganese			0.021	441.00	100%	yes	yes
Mercury	-	-	-	-	-	-	-
Nickel	-	-	-	-	-	-	-
Potassium	-	-	-	-	-	-	-
Selenium	-	-	-	-	-	-	-
Silver	-	-	-	-	-	-	-
Sodium	-	-	-	-	-	-	-
Thallium	-	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-	-
Zinc	-	-	-	-	-	-	-

**Notes:**

P,t,s - t-test type I error probability assuming separate (or unequal) variances

P,t,p - t-test type I error probability assuming pooled (or equal) variances

P,m-w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples

### 3.6.13.2 Site Assessment

Metals were detected above residential soil RBCs and acetone and TPH were detected above the CRLs in samples collected from the four soil borings. Metals concentrations did not exceed the background levels with the exception of manganese, a metallic alloy that may be attributed to the former UST stored on the surface. Compounds characteristically detected at firefighting training pits (i.e., PAHs and TPH) were not detected at significant concentrations in the soils sampled. Results from the SI sampling activities indicate that the actual location of the pit may not be established or that the surface of the pit where firefighting liquids were contained may be at depths that were not sampled. The Firefighter Training Pit location originally was determined based on guidance from VHFS personnel. Due to the inconsistent sampling results, further research on the pit location was conducted. This research indicated that the pit location may be approximately 100 feet southwest of the sampled area. Therefore, further surface and subsurface investigations are recommended at the other suspected Firefighter Training Pit location.

### 3.6.14 AREE 17 - Dump #3

Dump #3 has been used since 1958 to dispose of compost materials and construction debris. Initial sampling at this AREE consisted of installing four groundwater probes to determine the downgradient water quality and sampling the existing groundwater monitoring well. However, because the probes could not be pushed to the water table due to the presence of consolidated material, none of the probes contained groundwater. Followup investigations at this AREE consisted of installing and sampling three monitoring wells, one upgradient and two downgradient. The locations of the installed groundwater probes and wells are shown in Figure 3-20. The target compounds for the groundwater sample were VOCs, SVOCs, PCBs, pesticides, and total metals.

#### 3.6.14.1 Groundwater Sample Results

The results of the laboratory analyses for Dump #3 are provided in Appendix J. Table 3-46 provides the results for those compounds and analytes detected above the CRL. Seven metals (arsenic, aluminum, beryllium, iron, manganese, thallium, and vanadium), three

**Table 3-46. Data Summary Table: Groundwater - Dump #3 (AREE 17)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	GW09W	GW09W	MW-17-001	MW-17-002	MW-17-002
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01	SAIC02
Site Type	WELL	WELL	WELL	WELL	WELL
Collection Date	11/16/94	11/16/94	6/13/95	6/13/95	6/13/95
Depth (ft)	12.91	12.91	33.5	17.9	17.9
Associated Field QC Sample - Site ID					
Associated Field QC Sample - Field Sample No.					
Associated Field QC Sample - Site ID					
Associated Field QC Sample - Field Sample No.					

<b>METALSWATER/GFAA (AX3, SD16, SD26, 7041) (ug/L)</b>					
Laboratory ID Number	UB06306	UB06307	UC01797	UC01798	UC01799
Parameter	Units	CRL			
Arsenic	ug/L	2.35	LT	2.35	LT
Lead	ug/L	4.47	LT	4.47	LT
Selenium	ug/L	2.53	LT	2.53	LT

<b>METALSWATER/ICP (SS12, 6010) (ug/L)</b>					
Laboratory ID Number	UB06306	UB06307	UC01797	UC01798	UC01799
Parameter	Units	CRL			
Aluminum	ug/L	112	932	24500	1720
Barium	ug/L	2.82	208	64	360
Beryllium	ug/L	1.12	1.3	4.92	368
Calcium	ug/L	105	33800	128000	36000
Cobalt	ug/L	25	25	40.1	25
Copper	ug/L	18.8	18.8	27.3	18.8
Iron	ug/L	77.5	2830	75500	2790
Potassium	ug/L	1240	1240	2630	3240
Magnesium	ug/L	135	3780	9350	9250
Manganese	ug/L	9.67	58.7	1540	468
Sodium	ug/L	279	18900	16700	7050
Thallium	ug/L	2.44	2.44	10	10
Vanadium	ug/L	27.6	27.6	27.6	27.6
Zinc	ug/L	18	18	18	18

<b>VOLATILES/WATER/GCMS (UM21) (ug/L)</b>					
Laboratory ID Number	UB06306	UB06307	UC01797	UC01798	UC01799
Parameter	Units	CRL			
Acetone	ug/L	8	8	8	8
Methylene Chloride	ug/L	1	1	1	1
Toluene	ug/L	1	1	1	1
Trichloroethene	ug/L	1	1	1	1
TICs		0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

<b>SEMI-VOLATILES/WATER/GCMS (UM25) (ug/L)</b>					
Laboratory ID Number	UB06306	UB06307	UC01797	UC01798	UC01799
Parameter	Units	CRL			
Bis(2-Ethylhexyl)phthalate	ug/L	7.7	19	12.3	7.7
TICs		6 (93.0)	4 (85.0)	0 (0.0)	0 (0.0)

**Table 3-46. Data Summary Table: Groundwater - Dump #3 (AREE 17)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	GW08W	GW08W	GW08W	MW-17-001	MW-17-002	MW-17-002
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01	SAIC02
Site Type	WELL	WELL	WELL	WELL	WELL	WELL
Collection Date	11/16/94	11/16/94	11/16/94	6/13/95	6/13/95	6/13/95
Depth (ft)	12.91	12.91	12.91	33.5	17.9	17.9
Associated Field QC Sample - Site ID						
Associated Field QC Sample - Field Sample No.						
Associated Field QC Sample - Site ID						
Associated Field QC Sample - Field Sample No.						
<b>POLYNUCLEAR AROMATIC HYDROCARBONS/WATER (B310) (ug/L)</b>						
Laboratory ID Number	UB06306	UB06307	UB06307	UC01797	UC01798	UC01799
Parameter	Units	CRL	Units	CRL	Units	CRL
Benzo(a)pyrene	ug/L	0.021	LT	0.0206** D	LT	0.0356* B
Benzo(k)fluoranthene	ug/L	0.019	LT	0.0193** D	LT	0.0198* D
Dibenz(a,h)anthracene/1,2:5,6-Dibenzanthracene	ug/L	0.04	LT	0.0396** D	LT	0.0388* D
<b>PHENOLS/WATER (B040) (ug/L)</b>						
Laboratory ID Number	UB06306	UB06307	UB06307	UC01797	UC01798	UC01799
Parameter	Units	CRL	Units	CRL	Units	CRL
Pentachlorophenol	ug/L	1	LT	1** 9	LT	1* 9
<b>PESTICIDES/WATER/GCEC (UH20) (ug/L)</b>						
Laboratory ID Number	UB06306	UB06307	UB06307	UC01797	UC01798	UC01799
Parameter	Units	CRL	Units	CRL	Units	CRL
alpha-BHC	ug/L	0.003	LT	0.0034** U	LT	0.0025* D
delta-BHC	ug/L	0.003	LT	0.0034** U	LT	0.00647* UD
Endosulfan Sulfate	ug/L	0.003	GT	1.2** ZQBG	ND	0.0025* T
4,4'-DDE	ug/L	0.004	GT	0.00547** UDG	LT	0.0039* D
4,4'-DDT	ug/L	0.003	GT	0.031** UDGB	LT	0.0025* D
<b>TOTAL LEAD/WATER (SD18) (ug/L)</b>						
Laboratory ID Number	N/A	N/A	N/A	N/A	N/A	N/A
Parameter	Units	CRL	Units	CRL	Units	CRL
Total Lead	ug/L	4.47	N/A	N/A	N/A	N/A

**Table 3-46. Data Summary Table: Groundwater - Dump #3 (AREE 17)**  
**Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	MW-17-003	Residential Tap Water RBCs	Adjusted Residential Tap Water RBCs
Field Sample Number	SAIC01		
Site Type	WELL		
Collection Date	6/13/95		
Depth (ft)	20.2		
Associated Field QC Sample - Site ID			
Associated Field QC Sample - Field Sample No.			
Associated Field QC Sample - Site ID			
Associated Field QC Sample - Field Sample No.			

<b>METALSWATER/GFAA (AX8, SD18, SD26, 7041) (ug/L)</b>			
Laboratory ID Number	UC01801		
Parameter	Units	CRL	
Arsenic	ug/L	2.35	LT 2.35*
Lead	ug/L	4.47	LT 4.47*
Selenium	ug/L	2.53	LT 2.53*
			0.045c/11n
			N/A
			180
			1.6n

<b>METALSWATER/ICP (SS12, 6010) (ug/L)</b>			
Laboratory ID Number	UC01801		
Parameter	Units	CRL	
Aluminum	ug/L	112	260*
Barium	ug/L	2.82	224*
Beryllium	ug/L	1.12	1.57*
Calcium	ug/L	105	40800*
Cobalt	ug/L	25	LT 25*
Copper	ug/L	18.8	LT 18.8*
Iron	ug/L	77.5	304*
Potassium	ug/L	1240	2730*
Magnesium	ug/L	135	13100*
Manganese	ug/L	9.67	1680*
Sodium	ug/L	279	9090*
Thallium	ug/L	2.44	LT 10*
Vanadium	ug/L	27.6	LT 27.6*
Zinc	ug/L	18	LT 18*
			5290
			370
			0.016c/182n
			N/A
			2200
			1500
			11000
			N/A
			N/A
			180
			N/A
			N/A
			2.9
			0.41
			260
			37
			11000

<b>VOLATILESWATER/GCMS (UM21) (ug/L)</b>			
Laboratory ID Number	UC01801		
Parameter	Units	CRL	
Acetone	ug/L	8	LT 8*
Methylene Chloride	ug/L	1	LT 1*
Toluene	ug/L	1	LT 1*
Trichloroethene	ug/L	1	LT 1*
TICs			0 (0.0)
			3700
			4.1
			750
			1.6

<b>SEMI-VOLATILESWATER/GCMS (UM25) (ug/L)</b>			
Laboratory ID Number	UC01801		
Parameter	Units	CRL	
bis(2-Ethylhexyl)phthalate	ug/L	7.7	LT 7.7*
TICs			0 (0.0)
			4.8

**Table 3-46. Data Summary Table: Groundwater - Dump #3 (AREE 17)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	MW-17-003	Residential Tap Water RBCs
Field Sample Number	SAIC01	(EPA 1996)
Site Type	WELL	
Collection Date	6/13/95	
Depth (ft)	20.2	
Associated Field QC Sample - Site ID		
Associated Field QC Sample - Field Sample No.		
Associated Field QC Sample - Site ID		
Associated Field QC Sample - Field Sample No.		
<b>POLYNUCLEAR AROMATIC HYDROCARBONS/WATER (B310) (ug/L)</b>		
Laboratory ID Number	UC01801	
Parameter	Units	CRL
Benzo(a)pyrene	ug/L	0.021
Benzo(k)fluoranthene	ug/L	0.019
Dibenz(a,h)anthracene/1,2,5,6-Dibenzanthracene	ug/L	0.04
	LT	0.0192*
	LT	0.0198*
	LT	0.0388*
<b>PHENOLS/WATER (B040) (ug/L)</b>		
Laboratory ID Number	UC01801	
Parameter	Units	CRL
Pentachlorophenol	ug/L	1
		1.95* 9
		0.56
<b>PESTICIDES/WATER/OCCEC (UH20) (ug/L)</b>		
Laboratory ID Number	UC01801	
Parameter	Units	CRL
alpha-BHC	ug/L	0.003
delta-BHC	ug/L	0.003
Endosulfan Sulfate	ug/L	0.003
4,4'-DDE	ug/L	0.004
4,4'-DDT	ug/L	0.003
	LT	0.0025*
	LT	0.0025*
	LT	0.0034*
	ND	0.0025* T
	LT	0.0039*
	LT	0.0025*
<b>TOTAL LEAD/WATER (SD18) (ug/L)</b>		
Laboratory ID Number		N/A
Parameter	Units	CRL
Total Lead	ug/L	4.47
		N/A

**Footnotes:**

\* - Data collected from chemical transfer file (Phase I)  
 \*\* - Data collected from USAEC Pyramid system (Phase III)

CRL - Certified reporting limit

ID - Identification

N/A - Not applicable

QC - Quality control

TICs - Tentatively Identified Compound; number of TICs (total value)

**Boolean Codes**

LT - Less than the certified reporting limit / method detection level

**Flagging Codes**

B - Analyte found in the method blank or QC blank as well as the sample.

D - Duplicate analysis.

Q - Sample interference obscured peak of interest.

U - Analysis is unconfirmed.

Z - Non-target compound analyzed for and detected (non-GC/MS methods)

T - Non-target compound analyzed for but not detected (non-GC/MS methods)

9 - Non-demonstrated/validated method performed for USAEC.

G - Analyte found in the rinse blank as well as the sample.

For analytes flagged with "A," "G," "B," "U," or "I," half the detected value was compared with the RBC.

SVOCs (bis[2-ethylhexyl]phthalate, benzo[a]pyrene, and dibenzo[a,h]anthracene), and one phenol (pentachlorophenol) were detected above their adjusted tap water RBCs. As shown in Table 3-47, the concentrations of beryllium, thallium, pentachlorophenol, and bis(2-ethylhexyl)phthalate also exceeded drinking water MCLs. Two VOCs (toluene and trichloroethene) and four pesticides (alpha-BHC, endosulfan sulfate, 4,4'-DDE, and 4,4'-DDT) were detected at low concentrations below the protection standards. However, all four pesticides had multiple flags to indicate unconfirmed concentrations and/or the analyte was found in the rinse blank and its presence is considered suspect. No PCBs were detected above the CRL.

The upgradient monitoring well (MW-17-001) contained the highest concentrations of most of the metals (aluminum, beryllium, calcium, cobalt, copper, iron, lead, magnesium, selenium, thallium, vanadium, and zinc). This may be attributed to the fact that the upgradient well was a very slow recharger and could not be developed sufficiently to eliminate all fine particulates in the surrounding area. When the sample was acidified, the particulate metals dissolved into solution and gave an artificially high result.

#### **3.6.14.2 Site Assessment**

Metals, SVOCs, and phenols were detected above tap water RBCs and drinking water MCLs in groundwater wells downgradient from the dump. VOCs also were detected in the groundwater at low concentrations below the protection standards. Systematic soil sampling within Dump #3 is recommended to determine if the soils are the source of the contaminants. An additional round of groundwater sampling using filtered samples also is recommended to determine which metals are present at concentrations above background.

#### **3.6.15 AREE 18 - Grease Pit**

The Grease Pit was a 4-foot deep trench used to dispose of kitchen grease and possibly motor oil. The pit was covered with fill material in 1981, and has not been used since that time. The exact location of this AREE is somewhat uncertain. The pit was originally believed to be located in the area immediately northwest of Dump #3 (AREE 17) based on aerial photographs and personnel interviews. However, VHFS staff subsequently determined that the Firefighter Training Pit (AREE 16) was located at that area. The aerial photographs were reviewed again,

**Table 3-47. ARARs Comparison for Groundwater at AREE 17 - Dump #3  
Vint Hill Farms Station, Warrenton, Virginia**

Chemical	Maximum Contaminant Level Comparison							Regulatory Source
	Proportion exceeding	Sample ID		Max Sample Conc. (µg/L)	MCL (µg/L)			
		Site ID	Sample Type			Field Sample		
Beryllium	1/6	MW-17-001	WELL	SAIC01	4.92	4	Final	Federal
Thallium	1/6	MW-17-001	WELL	SAIC01	6.35	2	Final	Federal
Pentachlorophenol	2/6	GW09W/MW-17-003	WELL	SAIC01	2.26	1	Final	Federal
Bis(2-ethylhexyl)phthalate	3/6	GW09W/MW-17-002	WELL	SAIC01/SAIC02	21.0	6	Final	Federal

Chemical	Maximum Contaminant Level Goal Comparison						Federal Status	Regulatory Source
	Proportion exceeding	Sample ID	Max Sample Conc. (µg/L)	MCLG (µg/L)				
		Site ID			Sample Type	Field Sample		
Bis(2-ethylhexyl)phthalate	3/6	GW09W/MW-17-002	WELL	SAIC01/SAIC02	21.0	0	Final	Federal
	1/2	GW09W	WELL	ESE	22.20 *	0	Final	Federal

\* Dissolved lead  
 ESE - Samples collected by ESE in August 1984  
 SAIC01 - Samples collected by SAIC in November 1994 and June 1995  
 MCL - Maximum Contaminant Level  
 MCLG - Maximum Contaminant Level Goal

Sources:  
 Drinking Water Regulations and Health Advisories, EPA, February 1996, Office of Water, Washington, D.C.  
 Water Quality Criteria - 56 FR 223,58418 (Nov., 1991), \*Amendments to the Water Quality Standards Regulation, Compliance with  
 CWA Section 303 (c)(2)(B), Proposed Rule - Washington D.C.  
 State Drinking Water Standards - The Bureau of National Affairs, Inc. (BNA), CD-ROMS, August 1994



and sampling locations were placed in a nearby area. Sampling at this AREE consisted of drilling two soil borings within the probable location of the pit, with samples collected at the location of the pit bottom (i.e., 4 to 6 feet BLS). Figure 3-20 shows the locations of the soil borings at the Grease Pit. Boring SB-18-001 was completed to a depth of 6 feet and the samples were collected from the 4- to 6-foot BLS range. Boring SB-18-002 was completed to a depth of 5 feet because an impenetrable layer of saprolite was encountered at that depth. The sample was collected from the 4- to 5-foot BLS interval. The target analytes at this AREE were metals and TPH. TPH was analyzed by EPA Method SW8015 in order to provide fractions of gasoline and diesel.

#### **3.6.15.1 Soil Boring Results**

The results of the laboratory analyses for the Grease Pit are provided in Appendix J. Table 3-48 provides the results and RBCs for those contaminants detected above the CRL. Two metals (beryllium and iron) were detected above adjusted residential soil RBCs. As shown in Table 3-49, the beryllium and iron concentrations did not exceed background according to the UTL test. TPH gasoline and diesel fractions were not detected above the CRL in either of the boring samples.

#### **3.6.15.2 Site Assessment**

Uncertainty remains regarding the exact location used to dispose of kitchen grease and possibly motor oil. The Grease Pit location originally was determined based on guidance from VHFS personnel and the estimated proximity of the pit to the Firefighter Training Pit (AREE 16). However, VHFS aerial photographs indicate that the Grease Pit may have been located in the area investigated during the SI as the Firefighter Training Pit (AREE 16). Concentrations of target compounds and analytes indicative of contamination were not detected in the soils sampled at the Grease Pit. TPH fractions were not detected. No metals exceeded the residential soil RBCs with the exception of beryllium and iron, which were within background concentrations. No further activities are recommended for the area that was investigated as the Grease Pit. Due to the uncertainty regarding the Grease Pit location, subsurface investigations are recommended in the area now believed to be the correct location of AREE 18.

**Table 3-48. Data Summary Table: Soil - Grease Pit (AREE 18)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SB-18-001	SB-18-002	Residential RBCs	Adjusted Residential RBCs
Field Sample Number	SAIC01	SAIC01	(EPA 1996)	
Site Type	GSDA	GSDA		
Collection Date	11/1/94	11/2/94		
Depth (ft)	4	4		

<b>METALS/SOIL/GFAA (B9, JD20, JD21) (ug/g)</b>			
Laboratory ID Number	UB06103	UB06111	
Parameter	Units	CRL	
Lead	ug/g	0.467	1.43**
			N/A

<b>METALS/SOIL/ICP (JS12) (ug/g)</b>			
Laboratory ID Number	UB06103	UB06111	
Parameter	Units	CRL	
Aluminum	ug/g	11.2	24400**
Barium	ug/g	3.29	482**
Beryllium	ug/g	0.427	1.96**
Calcium	ug/g	25.3	872**
Cobalt	ug/g	2.5	59.8**
Chromium	ug/g	1.04	32.2**
Copper	ug/g	2.84	48.4**
Iron	ug/g	6.66	31800**
Potassium	ug/g	131	737**
Magnesium	ug/g	10.1	5980**
Manganese	ug/g	9.87	2300**
Sodium	ug/g	38.7	58.2**
Nickel	ug/g	2.74	39.6**
Vanadium	ug/g	1.14	52.3**
Zinc	ug/g	2.34	82.8**
			78000
			5500
			0.15c/390n
			N/A
			4700
			390
			28.7**
			41.9**
			3100
			23000
			26200**
			853**
			5030**
			316**
			57.1**
			17.1**
			1600
			550
			23000
			7670
			3650

Footnotes:  
 \* - Data collected from chemical transfer file (Phase I)  
 \*\* - Data collected from USAEC Pyramid system (Phase III)  
 CRL - Certified reporting limit  
 ID - Identification  
 N/A - Not applicable  
 QC - Quality control  
 TICs - Tentatively Identified Compound: number of TICs (total value)

**Table 3-49. Background Soil Comparison-Grease Pit (AREE 18)  
Vint Hill Farms Station, Warrenton, Virginia**

Substance	AREE 18 SOIL					Differs from Background?	
	P,t,s	P,t,p	P,m-w	UTL (ppm)	% > UTL	Upper Tail (UTL test)	
Aluminum	-	-	-	-	-	-	-
Arsenic	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-
Beryllium	-	-	-	5.10	0%	-	no
Cadmium	-	-	-	-	-	-	-
Calcium	-	-	-	-	-	-	-
Chromium	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-
Copper	-	-	-	-	-	-	-
Iron	-	-	-	180000.00	0%	-	no
Lead	-	-	-	-	-	-	-
Magnesium	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-
Mercury	-	-	-	-	-	-	-
Nickel	-	-	-	-	-	-	-
Potassium	-	-	-	-	-	-	-
Selenium	-	-	-	-	-	-	-
Silver	-	-	-	-	-	-	-
Sodium	-	-	-	-	-	-	-
Thallium	-	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-	-
Zinc	-	-	-	-	-	-	-

**Notes:**

P,t,s - t-test type I error probability assuming separate (or unequal) variances

P,t,p - t-test type I error probability assuming pooled (or equal) variances

P,m-w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples

### **3.6.16 AREE 19 - Pistol Range**

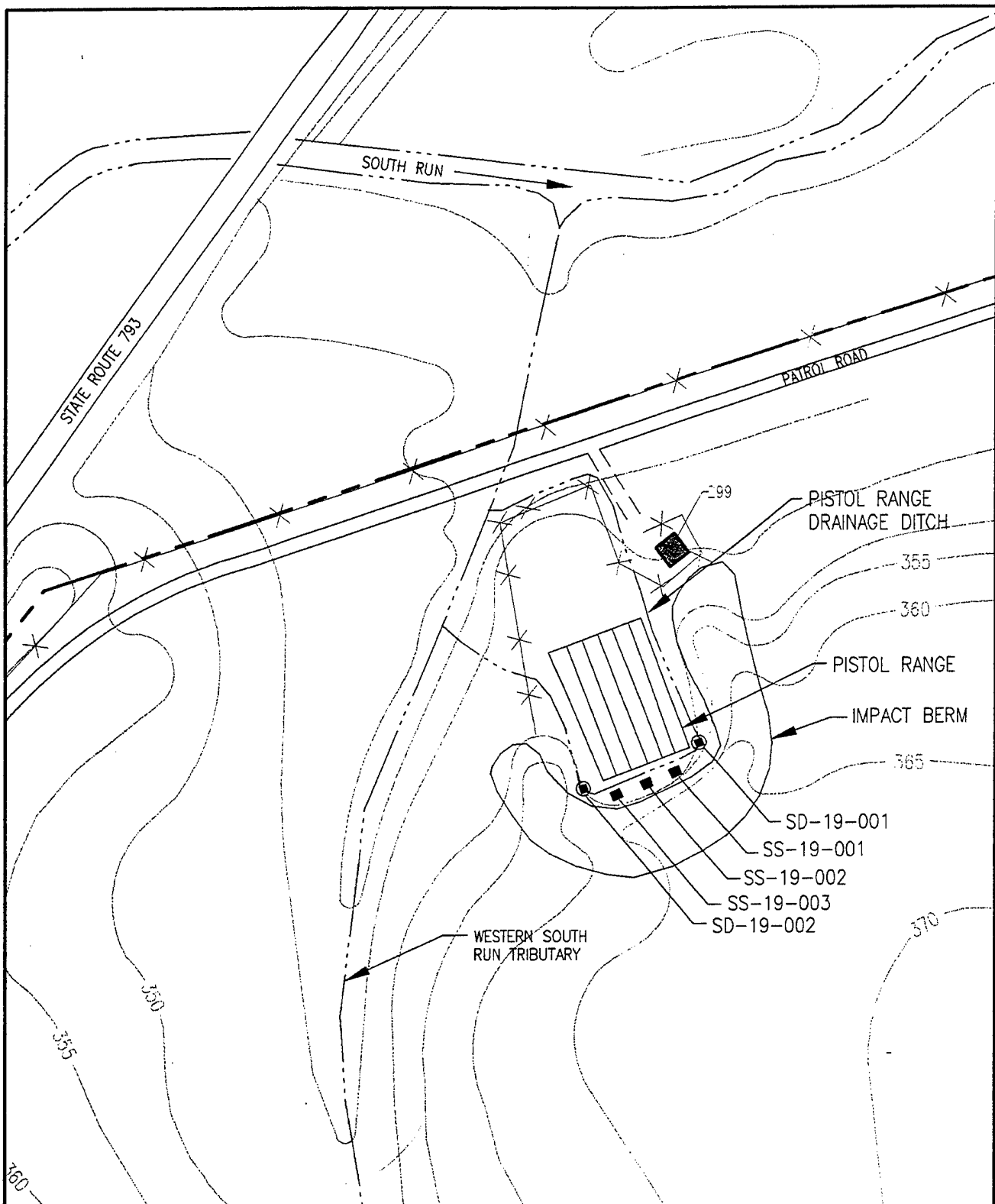
The Pistol Range has been used since 1961 for limited target practice. The firing fan is directed southward toward a horseshoe-shaped dirt bank that captures the bullets. Sampling at this AREE consisted of collecting three surface soil samples from the base of the impact berm and two surface sediment samples from within the drainage ditch that encircles the south end of the range. Figure 3-21 shows the locations of the surface soil and sediment samples taken at the Pistol Range. The target compounds at this AREE were total lead and organic lead. Soil parameters, including redox potential, toc, pH, moisture, and grain size, also were determined.

#### **3.6.16.1 Surface Soil and Sediment Results**

The results of the laboratory analyses for the Pistol Range are provided in Appendix J. Table 3-50 provides the results for total lead, which was detected above the CRL, and for selected soil parameters. As shown in Table 3-51, lead concentrations in the samples exceeded background concentrations, as indicated by both the t-test and the UTL test. The maximum total lead concentration detected in the impact berm (3,200  $\mu\text{g/g}$ ) exceeds the EPA screening level for lead in soil for residential land use of 400 ppm (EPA 1994). Both sediment samples in the drainage ditch had lead concentrations that exceeded the NOAA ER-L concentration of 35  $\mu\text{g/g}$  and one sample exceeded the NOAA ER-M concentration of 110  $\mu\text{g/g}$ . One sediment sample (SD-19-002) also had a lead concentration that exceeded the NOAA ER-M concentration of 110  $\mu\text{g/g}$ . Organic lead was not detected above the CRL in either the soil or the sediment samples taken at this AREE. Redox potential in the soil and sediment ranged from 523 to 613 mV, which indicates that the environment is oxidizing. The pH range in soils at the Pistol Range was 6.13 to 7.53, or generally neutral. Lead is considered to have low mobility; however, oxidizing conditions enhance its mobility (Swartzbaugh et al. 1992). In addition, the soils from the impact berm were clayey fine-to-coarse sand, as determined by grain size analysis (Appendix H), which also would allow for enhanced lead mobility.

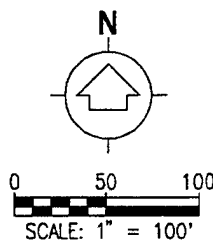
#### **3.6.16.2 Site Assessment**

Samples collected from the Pistol Range contained concentrations of total lead that exceeded background concentrations, although no organic lead was detected. The Pistol Range



**LEGEND**

- ..... BUILDING
- x-x-x- FENCE
- - - - - VHFS BOUNDARY
- ===== PAVED ROAD
- ~~~~~ STREAM
- ..... SURFACE SOIL SAMPLE
- ..... SEDIMENT SAMPLE



<b>SAIC</b> Science Applications International Corporation			
<b>VINT HILL FARMS STATION</b> <b>WARRENTON, VIRGINIA</b> <b>SI REPORT</b>			
<b>AREA 19 - PISTOL RANGE</b>			
Figure: 3-21	Project: 01-0827-03-6521-060	File Name: 95005\DWGS\036F313A	Date: 03-28-95

**Table 3-50. Data Summary Table: Soil and Sediment - Pistol Range (AREE 19)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SD-19-001	SD-19-002	SS-19-001	SS-19-002
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01
Site Type	DITCH	DITCH	SURF	SURF
Collection Date	11/8/94	11/8/94	11/8/94	11/8/94
Depth (ft)	0	0	0	0
	Sediment	Sediment		
<b>TOTAL LEAD/SOIL (JD21) (ug/g)</b>				
Laboratory ID Number	UB06178	UB06179	UB06180	UB06181
Parameter	Units	CRL		
Total Lead	ug/g	0.467	98**	400**
			3200**	2100** D
				260**
<b>SOIL PARAMETERS</b>				
Parameter	Units	CRL		
Total Organic Carbon	ug/g	1000	10500*	6550*
pH			6.13*	7.07*
Redox Potential	mV		585*	613*
			2770*	7.05*
			574*	575*
			N/A	N/A
			N/A	N/A
			1150*	6.85*
				575*

**Table 3-50. Data Summary Table: Soil and Sediment - Pistol Range (AREE 19)**  
**Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	SS-19-003	ER-L	ER-M
Field Sample Number	SAIC01	(NOAA 1991)	(NOAA 1991)
Site Type	SURF	For Sediment	For Sediment
Collection Date	11/8/94		
Depth (ft)	0		
<b>TOTAL LEAD/SOIL (JD21) (ug/g)</b>			
Laboratory ID Number	UB06183		
Parameter	Units	CRL	
Total Lead	ug/g	0.467	35
			110
<b>SOIL PARAMETERS</b>			
Parameter	Units	CRL	
Total Organic Carbon	ug/g	1000	N/A
pH		4020*	N/A
Redox Potential	mV	7.53*	N/A
		523*	N/A

Footnotes:  
 \* - Data collected from chemical transfer file (Phase I)  
 \*\* - Data collected from USAEC Pyramid system (Phase III)  
 CRL - Certified reporting limit  
 ID - Identification  
 N/A - Not applicable  
 QC - Quality control  
 TICs - Tentatively Identified Compound: number of TICs (total value)  
 Flagging Codes  
 D - Duplicate analysis.

**Table 3-51. Background Soil Comparison-Pistol Range (AREE 19)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Substance	AREE 19 SOIL					Differs from Background?	
	P,t,s	P,t,p	P,m-w	UTL (ppm)	% > UTL	Central Tendency	Upper Tail
						(t-test, MW test)	(UTL test)
Aluminum	-	-	-	-	-	-	-
Arsenic	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-
Beryllium	-	-	-	-	-	-	-
Cadmium	-	-	-	-	-	-	-
Calcium	-	-	-	-	-	-	-
Chromium	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-
Copper	-	-	-	-	-	-	-
Iron	-	-	-	-	-	-	-
Lead	-	-	0.014	13.00	100%	yes	yes
Magnesium	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-
Mercury	-	-	-	-	-	-	-
Nickel	-	-	-	-	-	-	-
Potassium	-	-	-	-	-	-	-
Selenium	-	-	-	-	-	-	-
Silver	-	-	-	-	-	-	-
Sodium	-	-	-	-	-	-	-
Thallium	-	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-	-
Zinc	-	-	-	-	-	-	-

**Notes:**

P,t,s - t-test type I error probability assuming separate (or unequal) variances

P,t,p - t-test type I error probability assuming pooled (or equal) variances

P,m-w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples



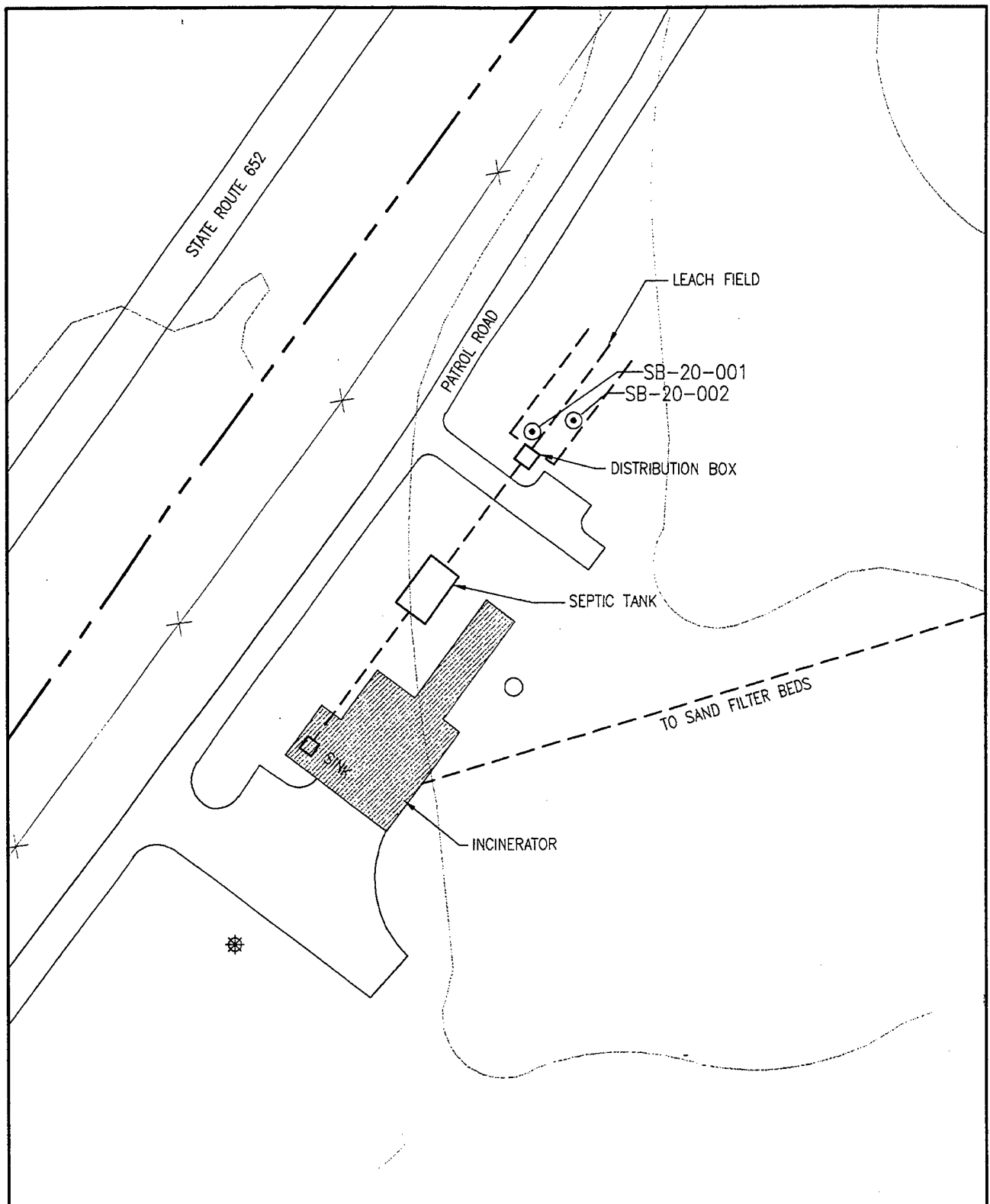
is located adjacent to the north end of the western South Run tributary, and concentrations of lead above the EPA screening level are present in the impact berm. In addition, concentrations of lead above the NOAA ER-L are present in the area of the drainage ditch closest to the tributary. Soil parameter data indicate that due to the nature of the soils and sediments, lead would have some potential for mobility at the Pistol Range. Therefore, due to the sandy soil type and the proximity of the drainage ditch to the western South Run tributary, recommendations for this AREE include further investigation of the drainage ditch sediments as well as investigation of the tributary surface water. In addition, subsurface soil borings in the impact berm area are recommended to determine the extent of lead migration.

### **3.6.17 AREE 20 - Incinerator**

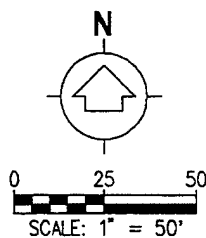
The Incinerator has its own septic system, which consists of a 500-gallon septic tank and a 135-foot leach field. The septic system is connected to the sinks and toilets in the Incinerator building. Spills of liquid hazardous wastes inside the Incinerator building could have been discharged to the septic system. Sampling at this AREE consisted of drilling two soil borings within the septic system leach field, with samples collected at an interval of 4 to 5.5 feet BLS. Weathered bedrock was encountered at a depth of 5.5 feet BLS in both boreholes. Figure 3-22 shows the locations of the soil borings at the Incinerator. Boring SB-20-002 was moved 10 feet northeast of the planned location because gravel was encountered during the first attempt to drill this borehole. The target compounds at this AREE were metals, VOCs, SVOCs, pesticides, and PCBs.

#### **3.6.17.1 Soil Boring Results**

The results of the laboratory analyses for the Incinerator are provided in Appendix J. Table 3-52 provides the results and RBCs for those contaminants detected above the CRL. Three metals (beryllium, aluminum, and iron) were detected above their adjusted residential soil RBCs. As shown in Table 3-53, these concentrations were below background concentrations according to the UTL test. No VOCs, SVOCs, pesticides, or PCBs were detected in either of the boring samples.



LEGEND	
	BUILDING
	ROAD
	FENCE
	STREAM
	PERFORATED PIPE
	NORMAL PIPE
	SITE BOUNDARY
	SOIL BORING
	DRY GROUNDWATER PROBE



 Science Applications International Corporation			
<b>VINT HILL FARMS STATION</b> <b>WARRENTON, VIRGINIA</b> <b>SI REPORT</b>			
<b>AREE 20 - INCINERATOR</b>			
Figure: 3-22	Project: 01-0827-03-6521-060	File Name: /95005/DWGS/036AR22B	Date: 03-28-95

**Table 3-52. Data Summary Table: Soil - Incinerator (AREE 20)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SB-20-001	SB-20-002	Residential RBCs Adjusted RBCs
Field Sample Number	SAIC01	SAIC01	(EPA 1996)
Site Type	BORE	BORE	
Collection Date	11/8/94	11/8/94	
Depth (ft)	4	4	
Associated Field QC Sample - Site ID			
Associated Field QC Sample - Field Sample No.			
Associated Field QC Sample - Site ID			
Associated Field QC Sample - Field Sample No.			
<b>METALS/SOIL/GFAA (B9, JD20, JD21) (ug/g)</b>			
Laboratory ID Number	UB06190	UB06191	
Parameter	Units	CRL	
Lead	ug/g	0.467	5.11**
			3.41**
			N/A
<b>METALS/SOIL/ICP (JS12) (ug/g)</b>			
Laboratory ID Number	UB06190	UB06191	
Parameter	Units	CRL	
Aluminum	ug/g	11.2	32700**
Barium	ug/g	3.29	149**
Beryllium	ug/g	0.427	1.53**
Calcium	ug/g	25.3	2440**
Cobalt	ug/g	2.5	51**
Chromium	ug/g	1.04	42.8**
Copper	ug/g	2.84	34.7**
Iron	ug/g	6.66	48900**
Potassium	ug/g	131	814**
Magnesium	ug/g	10.1	8880**
Manganese	ug/g	9.87	752**
Sodium	ug/g	38.7	66.2**
Nickel	ug/g	2.74	27.3**
Vanadium	ug/g	1.14	82.1**
Zinc	ug/g	2.34	94.1**
			12400**
			121**
			1.53**
			1200**
			8.13**
			16.7**
			4.59**
			17500**
			23000
			3100
			390
			98
			5750
			23000
			N/A
			291**
			1290**
			224**
			52.5**
			N/A
			1600
			6.57**
			69.6**
			550
			23000
			16.4**
			138
<b>SEMI-VOLATILES/SOIL/GCMS (LM25) (ug/g)</b>			
Laboratory ID Number	UB06190	UB06191	
Parameter	Units	CRL	
TiCs	ug/g	2 (1.1)	5 (3.4)
			N/A

Footnotes:  
 \* - Data collected from chemical transfer file (Phase I)  
 \*\* - Data collected from USAEC Pyramid system (Phase III)  
 CRL - Certified reporting limit  
 ID - Identification  
 N/A - Not applicable  
 QC - Quality control  
 TiCs - Tentatively identified Compound: number of TiCs (total value)

**Table 3-53. Background Soil Comparison-Incinerator (AREE 20)  
Vint Hill Farms Station, Warrenton, Virginia**

Substance	AREE 20 SOIL					Differs from Background?
	P,t,s	P,t,p	P,m-w	UTL (ppm)	% > UTL	Upper Tail (UTL test)
Aluminum	-	-	-	60600.00	0%	no
Arsenic	-	-	-	-	-	-
Barium	-	-	-	-	-	-
Beryllium	-	-	-	5.10	0%	no
Cadmium	-	-	-	-	-	-
Calcium	-	-	-	-	-	-
Chromium	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-
Copper	-	-	-	-	-	-
Iron	-	-	-	180000.00	0%	no
Lead	-	-	-	-	-	-
Magnesium	-	-	-	-	-	-
Manganese	-	-	-	-	-	-
Mercury	-	-	-	-	-	-
Nickel	-	-	-	-	-	-
Potassium	-	-	-	-	-	-
Selenium	-	-	-	-	-	-
Silver	-	-	-	-	-	-
Sodium	-	-	-	-	-	-
Thallium	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-
Zinc	-	-	-	-	-	-

**Notes:**

P,t,s - t-test type I error probability assuming separate (or unequal) variances

P,t,p - t-test type I error probability assuming pooled (or equal) variances

P,m-w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples

### 3.6.17.2 Streamlined Risk Assessment

A streamlined risk assessment was conducted for current and future land uses at AREE 20. Risks were calculated only for the soil ingestion pathway. As shown in Table 3-54, noncancer HIs did not exceed 1 and cancer risks did not exceed  $1 \times 10^{-4}$  for either the station or the construction worker. Under a residential land use scenario, the noncancer HIs were below 1 and the cancer risks were below  $1 \times 10^{-4}$  for both the child and adult receptors.

**Table 3-54. Risk Characterization Summary  
for Soil Ingestion at the Incinerator (AREE 20)**

Current Land Use				Future Land Use			
Noncancer HI		Cancer Risk		Noncancer HI		Cancer Risk	
Station Worker	Construction Worker	Station Worker	Construction Worker	Resident Child	Resident Adult	Resident Child	Resident Adult
0.06	0.3	2E-06	1E-06	0.7	0.08	7E-06	4E-06

### 3.6.17.3 Site Assessment

Soil samples were collected in the septic field in locations and at depths where discharges from the Incinerator into the septic system would have occurred. Metals were not detected above the adjusted residential soil RBCs with the exception of beryllium, aluminum (in one sample), and iron. Concentrations of all three metals were within background concentrations. In addition, no target compound organics were detected in either of the soil borings. Results from the streamlined risk assessment indicated that risks at AREE 20 for the soil ingestion pathway do not exceed EPA target levels under current or future land use scenarios. Based on these results, no further action is recommended at the Incinerator.

### 3.6.18 AREE 21 - Sand Filter Beds

The Sand Filter Beds received the ash wastewaters from the scrubber used for particulate control in the Incinerator smokestack. Initial sampling at this AREE consisted of collecting seven surface soil borings (four of which were within the filter beds), sampling one existing well (GW07W), and sampling the two downgradient groundwater push probes. The upgradient push probe was not sampled because it was dry. Followup sampling involved installing three

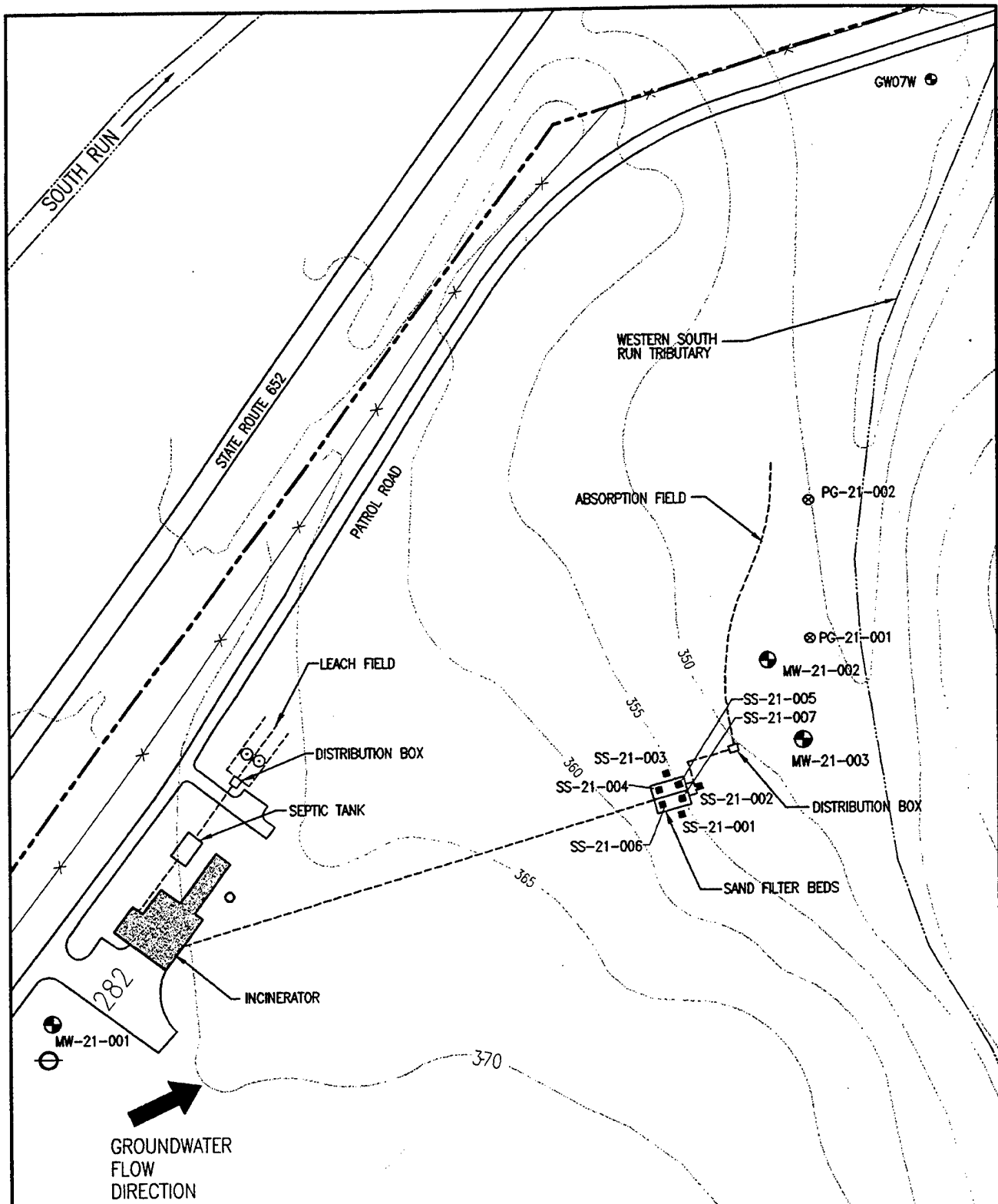
groundwater monitoring wells, one of which is upgradient of the Incinerator and two of which are downgradient from the leach fields. Figure 3-23 shows the locations of the surface soil and groundwater samples. The target analytes at this AREE were metals. Dioxins and furans were additional target compounds for the four surface soil samples collected from within the filter beds.

Prior to conducting sampling activities within the Sand Filter Beds, the vegetation, topsoil, and sand were moved to allow for easier sampling access. These materials were moved around inside the beds; no material was removed from the beds. Figure 3-24 provides a cross-section of the materials within the filter beds. One surface soil sample was collected from each filter bed in the black sand layer and one sample was collected in each filter bed from the lower layer of medium and coarse sand. Samples SS-21-004 and SS-21-006 were collected in the black sand layer and samples SS-21-005 and SS-21-007 were collected in the lowest sand layer. Three surface soil samples were collected outside of the filter beds, in areas where overflows from the filter beds would discharge.

Three groundwater push probes were installed at this AREE; however, only the two downgradient probes contained groundwater. The metals samples from these probes were collected over a period of days due to the low volumes of groundwater in the probes.

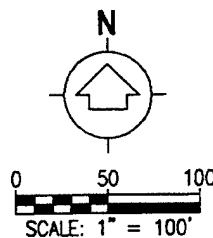
#### **3.6.18.1 Surface Soil Results**

The results of the soil laboratory analyses for the Sand Filter Beds are provided in Appendix J. Table 3-55 provides the results and residential soil RBCs for those analytes that were detected above the CRL. The soil samples collected inside the filter beds contained two metals (arsenic and iron) at concentrations that exceeded the adjusted residential soil RBCs. In addition, the dioxin OCDD was detected in two of the four samples taken from within the filter beds. At location SS-21-004, OCDD was detected at a maximum concentration of 0.26 ng/g, while at location SS-21-005, it was detected at a concentration of 0.20 ng/g. An RBC was not available for OCDD; however, because 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) is from the same chemical family as OCDD, an equivalent RBC for OCDD was derived from the TCDD RBC. The residential RBC for TCDD was divided by the toxicity equivalency factor for OCDD



#### LEGEND

- BUILDING
- PAVED ROAD
- FENCE
- STREAM
- GROUNDWATER MONITORING WELL
- PERFORATED PIPE
- SITE BOUNDARY
- SURFACE SOIL SAMPLE
- GROUNDWATER PUSH SAMPLE
- DRY PROBE

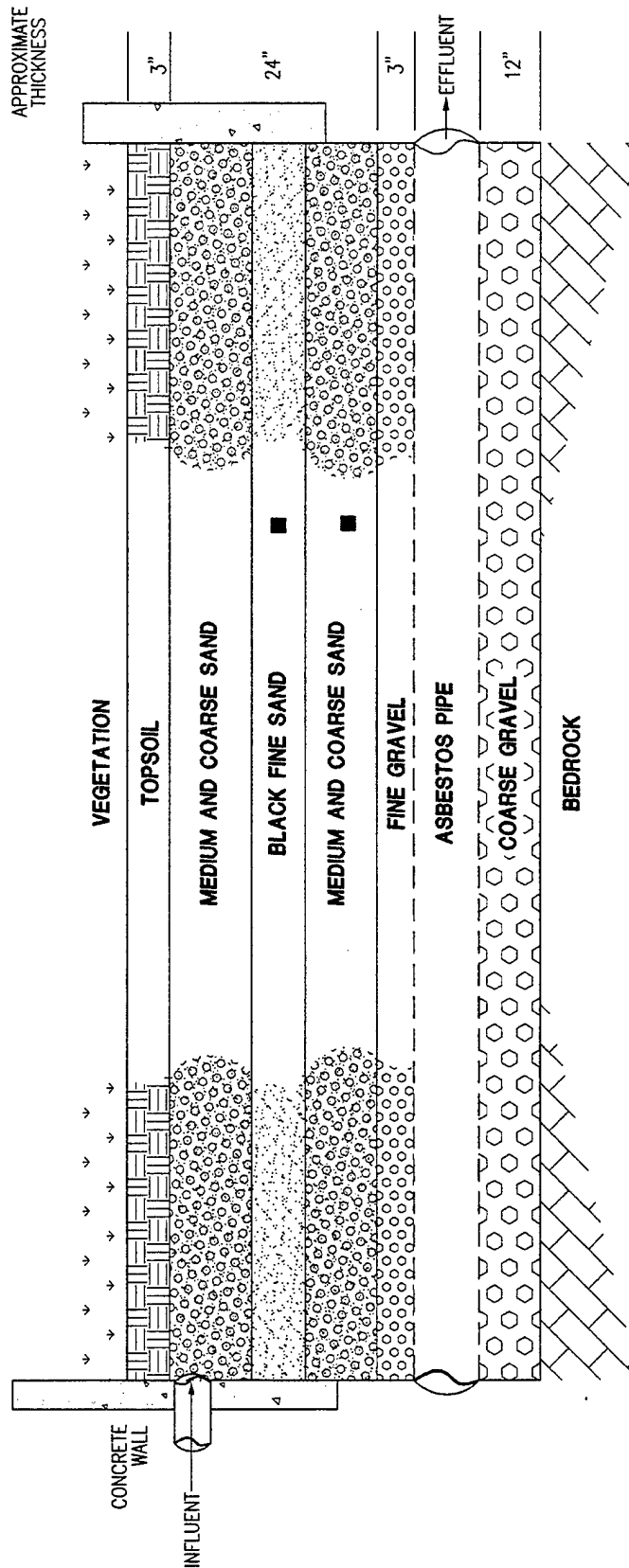


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### VINT HILL FARMS STATION WARRENTON, VIRGINIA SI REPORT

#### AREA 21-SAND FILTER BEDS

Figure: 3-23	Project: 01-0827-03-6521-062	File Name: /95005/DWGS/249F3-23	Date: 10-04-95
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#### LEGEND:

..... SURFACE SOIL SAMPLE

#### NOTE:

THIS CROSS SECTION WAS DIGITIZED FROM A FIELD SKETCH AND IS NOT TO SCALE.



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SI REPORT

#### AREE 21-SAND FILTER BEDS CROSS SECTION

Figure: 3-24 Project: 01-0827-03-6521-060 Date: 05-31-96  
File Name: 95005\DWGS\413CRS

NOT TO SCALE



**Table 3-55. Data Summary Table: Soil - Sand Filter Beds (AREE 21)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SS-21-001	SS-21-002	SS-21-003	SS-21-004	SS-21-004
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01	SAIC02
Site Type	SURF	SURF	SURF	SURF	SURF
Collection Date	11/9/94	11/9/94	11/9/94	11/14/94	11/14/94
Depth (ft)	0	0	0	0	0

<b>METALS/SOIL/CVAA (Y9) (ug/g)</b>	
Laboratory ID Number	UB06208
Parameter	Units CRL
Mercury	ug/g 0.05 LT 0.05**
	0.0743**
	LT 0.05**
	0.0961**
	0.092** D

<b>METALS/SOIL/GFAA (B9, JD20, JD21) (ug/g)</b>	
Laboratory ID Number	UB06208
Parameter	Units CRL
Arsenic	ug/g 2.5 LT 2.5**
Lead	ug/g 0.467 LT 6.26**
	4.12**
	34**
	3.17**
	14**
	3.49**
	44**
	3.15** D
	40** D

<b>METALS/SOIL/ICP (JS12) (ug/g)</b>	
Laboratory ID Number	UB06208
Parameter	Units CRL
Aluminum	ug/g 11.2 4680**
Barium	ug/g 3.29 27.5**
Beryllium	ug/g 0.427 LT 1.38**
Calcium	ug/g 25.3 491**
Cadmium	ug/g 1.2 LT 1.2**
Cobalt	ug/g 2.5 8.71**
Chromium	ug/g 1.04 14.3**
Copper	ug/g 2.84 9.86**
Iron	ug/g 6.66 14400**
Potassium	ug/g 131 568**
Magnesium	ug/g 10.1 668**
Manganese	ug/g 9.87 321**
Silver	ug/g 0.803 LT 0.803**
Sodium	ug/g 38.7 63.4**
Sulfur	ug/g 2.74 3.82**
Nickel	ug/g 1.14 20**
Vanadium	ug/g 2.34 52.9**
Zinc	ug/g 2.34 52.9**
	26800**
	154**
	1.38**
	1900**
	1.2**
	46**
	25.5**
	25.4**
	54200**
	734**
	1780**
	1240**
	0.803**
	53.4**
	18.7**
	150**
	144**
	29500**
	161**
	1.64**
	1950**
	1.2**
	38.8**
	31.9**
	24.3**
	57700**
	1240**
	2910**
	1300**
	14.7**
	68.1**
	2.74**
	14.8**
	144**
	3960**
	69.6**
	0.427**
	972**
	1.58**
	7.33**
	13.1**
	8.41**
	9500**
	11.4**
	14300**
	302**
	424**
	198**
	15**
	38.7**
	4.7**
	24.2**
	177**

<b>DIOXINS/FURANS/SOIL (B280) (pg/g)</b>	
Laboratory ID Number	UB06208
Parameter	Units CRL
OCDD	ng/g **
	N/A
	N/A
	0.26 Z
	0.2 Z

**Table 3-55. Data Summary Table: Soil - Sand Filter Beds (AREE 21)**  
**Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	SS-21-006	SS-21-006	SS-21-007	Residential RBCs Adjusted RBCs (EPA 1996)
Field Sample Number	SAIC01	SAIC01	SAIC01	
Site Type	SURF	SURF	SURF	
Collection Date	11/14/94	11/14/94	11/14/94	
Depth (ft)	0	0	0	

<b>METALS/SOIL/CVAA (Y9) (ug/g)</b>				
Laboratory ID Number	UB06277	UB06279	UB06278	
Parameter	Units	CRL		
Mercury	ug/g	0.05	0.072**	23

<b>METALS/SOIL/GFAA (B9, JD20, JD21) (ug/g)</b>				
Laboratory ID Number	UB06277	UB06279	UB06278	
Parameter	Units	CRL		
Arsenic	ug/g	2.5	LT	2.5**
Lead	ug/g	0.467	LT	27**
				0.43c23n
				N/A
				4.6n

<b>METALS/SOIL/ICP (JS12) (ug/g)</b>				
Laboratory ID Number	UB06277	UB06279	UB06278	
Parameter	Units	CRL		
Aluminum	ug/g	11.2	3720**	78000
Barium	ug/g	3.29	148**	5500
Beryllium	ug/g	0.427	LT	0.427**
Calcium	ug/g	25.3	541**	0.15/390n
Cadmium	ug/g	1.2	1.2**	N/A
Cobalt	ug/g	2.5	18.5**	78
Chromium	ug/g	1.04	5**	4700
Copper	ug/g	2.84	11**	390
Iron	ug/g	6.66	678**	10.8**
Potassium	ug/g	131	8830**	3100
Magnesium	ug/g	10.1	375**	23000
Manganese	ug/g	9.87	571**	N/A
Silver	ug/g	0.803	1500**	N/A
Sodium	ug/g	38.7	0.803**	10950
Nickel	ug/g	2.74	LT	390
Vanadium	ug/g	1.14	38.7**	N/A
Zinc	ug/g	2.34	4.03**	1600
			21.7**	550
			152**	110
				23000

<b>DIOXINS/FURANS/SOIL (R280) (ng/g)</b>				
Laboratory ID Number	UB06277	UB06279	UB06278	
Parameter	Units	CRL		
OCDD	ng/g	***	0.2 Z	ND
			0.033 W	ND
				0.075
				4.1***

Footnotes:  
 \* - Data collected from chemical transfer file (Phase I)  
 \*\* - Data collected from USAEC Pyramid system (Phase III)  
 \*\*\* - Sample specific estimated detection limit  
 \*\*\*\* - RBC derived from 2,3,7,8-TCDD equivalents  
 CRL - Certified reporting limit  
 N/A - Not applicable  
 QC - Quality Control  
 TICs - Tentatively Identified Compound: number of TICs (total value)  
 ID - Identification  
 c - Carcinogenic effects.  
 n - Noncarcinogenic effects.  
 Flagging Codes:  
 D - Duplicate analysis  
 Z - Result detected is below the lowest standard and above zero  
 W - Estimated maximum possible concentration.

(0.001) to obtain a reasonable RBC for OCDD (EPA 1989b). The RBC for TCDD is 0.0000041 mg/kg; therefore, the equivalent RBC for OCDD is 0.0041 mg/kg or 4.1 ng/g. Thus, the maximum concentration of OCDD (0.26 ng/g) detected at the Sand Filter Beds is lower than the equivalent RBC.

As indicated in Table 3-55, the soil samples collected outside the filter beds contained five metals (arsenic, aluminum, beryllium, iron, and vanadium) at concentrations that exceeded their adjusted residential soil RBCs. As Table 3-56 shows, only arsenic exceeded background concentrations because it was not detected in the background samples. The maximum concentration of arsenic (4.12  $\mu\text{g/g}$ ) was below the regional average for arsenic (4.8  $\mu\text{g/g}$ ).

### 3.6.18.2 Groundwater Results

The results of the groundwater laboratory analyses for the Sand Filter Beds are provided in Appendix J. Table 3-57 provides the results for those metals detected above the CRL. Four metals (arsenic, beryllium, iron, and manganese) were detected above their adjusted tap water RBCs in at least one monitoring well. Concentrations of arsenic, barium, beryllium, calcium, potassium, magnesium, and sodium in the three downgradient wells (GW07W, MW-21-002, and MW-21-003) were all higher than the concentrations in the upgradient well (MW-21-001). However, none of the concentrations of metals was above drinking water MCLs. The samples collected from the push probes contain extremely high metals concentrations due to the levels of sediment in the samples. These data are considered to be nonrepresentative of groundwater conditions at this AREE and comparison to tap water RBCs or MCLs for the push probe metals data was not conducted.

As shown in Section 3.1.2, groundwater flows toward the western South Run tributary (to the northeast) at this AREE. Correspondingly, the highest concentrations of metals were detected in the northernmost wells (GW07W and MW-21-003). These results indicate that the Incinerator washwaters discharged to the leach field may be migrating through the surficial groundwater.

**Table 3-56. Background Soil Comparison-Sand Filter Beds (AREE 21)  
Vint Hill Farms Station, Warrenton, Virginia**

Substance	AREE 21 SOIL (outside filter beds)					Differs from Background?
	P,t,s	P,t,p	P,m-w	UTL (ppm)	% > UTL	
						Upper Tail (UTL test)
Aluminum	-	-	-	60600.00	0%	no
Arsenic	-	-	-	-	-	yes; NDB
Barium	-	-	-	-	-	-
Beryllium	-	-	-	5.10	0%	no
Cadmium	-	-	-	-	-	-
Calcium	-	-	-	-	-	-
Chromium	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-
Copper	-	-	-	-	-	-
Iron	-	-	-	180000.00	0%	no
Lead	-	-	-	-	-	-
Magnesium	-	-	-	-	-	-
Manganese	-	-	-	-	-	-
Mercury	-	-	-	-	-	-
Nickel	-	-	-	-	-	-
Potassium	-	-	-	-	-	-
Selenium	-	-	-	-	-	-
Silver	-	-	-	-	-	-
Sodium	-	-	-	-	-	-
Thallium	-	-	-	-	-	-
Vanadium	-	-	-	531.000	0%	no
Zinc	-	-	-	-	-	-

**Notes:**

P,t,s - t-test type I error probability assuming separate (or unequal) variances

P,t,p - t-test type I error probability assuming pooled (or equal) variances

P,m-w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples

**Table 3-57. Data Summary Table: Groundwater - Sand Filter Beds (AREE 21)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	GW07W	MW-21-001	MW-21-002	MW-21-003	PG-21-001
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01
Site Type	WELL	WELL	WELL	WELL	WELL
Collection Date	11/11/94	6/12/95	6/12/95	6/12/95	11/16/94
Depth (ft)	15.88	8.4	10.09	21.56	3.49
Associated Field QC Sample - Site ID					
Associated Field QC Sample - Field Sample No.					
Associated Field QC Sample - Site ID					
Associated Field QC Sample - Field Sample No.					

<b>METALS/WATER/GFAA (AX3, SD19, SD25, 7041) (ug/L)</b>					
Laboratory ID Number	UB06254	UC01802	UC01804	UC01803	UB06299
Parameter					
Arsenic	ug/L 2.35	LT 2.35*	2.41*	4.69*	9.4**
Lead	ug/L 4.47	LT 4.47**	LT 4.47*	LT 4.47*	11.6**

<b>METALS/WATER/CVAA (CC8) (ug/L)</b>					
Laboratory ID Number	UB06254	UC01802	UC01804	UC01803	UB06299
Parameter					
Mercury	ug/L 0.1	LT 0.1*	LT 0.1*	LT 0.1*	0.134**

<b>METALS/WATER/ICP (SS12, 8010) (ug/L)</b>					
Laboratory ID Number	UB06254	UC01802	UC01804	UC01803	UB06299
Parameter					
Aluminum	ug/L 112	1570*	894*	5650*	24000**
Barium	ug/L 2.82	27.1*	116*	371*	2460**
Beryllium	ug/L 1.12	1.12*	1.3*	3.13*	21.5**
Calcium	ug/L 105	5530*	33800*	60000*	86300**
Cobalt	ug/L 25	25*	25*	25*	297**
Chromium	ug/L 16.8	16.8*	16.8*	16.8*	440**
Copper	ug/L 18.8	18.8*	18.8*	22*	130**
Iron	ug/L 77.5	2780*	793*	4510*	640000**
Potassium	ug/L 1240	1650*	1810*	1840*	41600**
Magnesium	ug/L 135	2240*	5150*	8610*	126000**
Manganese	ug/L 9.67	90.3*	46.2*	210*	13000**
Sodium	ug/L 279	4270*	10900*	17500*	28100**
Nickel	ug/L 32.1	32.1*	32.1*	32.1*	434**
Thallium	ug/L 2.44	LT 10*	LT 10*	LT 10*	5.76**
Vanadium	ug/L 27.6	LT 27.6**	LT 27.6*	LT 27.6*	610**
Zinc	ug/L 18	18*	18*	18*	1390**

**Table 3-57. Data Summary Table: Groundwater - Sand Filter Beds (AREE 21)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	Site Sample Number	PG-21-002	Residential Tap Water RBCs (EPA 1996)	Adjusted Tap Water RBCs
Field Sample	SAIC01			
Site Type	WELL			
Collection Date	11/16/94			
Depth (ft)	3.96			
Associated Field QC Sample - Site ID				
Associated Field QC Sample - Field Sample No.				
Associated Field QC Sample - Site ID				
Associated Field QC Sample - Field Sample No.				
<b>METALS/WATER/GFAA (AL3, SD18, SD25, 7041) (ug/L)</b>				
Laboratory ID Number	UB06372			
Parameter	Units	CRL		
Arsenic	ug/L	2.35	14.6**	2.2n
Lead	ug/L	4.47	1100**	N/A
<b>METALS/WATER/CVAA (CC8) (ug/L)</b>				
Laboratory ID Number	UB06372			
Parameter	Units	CRL		
Mercury	ug/L	0.1	0.688**	11
<b>METALS/WATER/ICP (SS12, 6010) (ug/L)</b>				
Laboratory ID Number	UB06372			
Parameter	Units	CRL		
Aluminum	ug/L	112	270000**	7400
Barium	ug/L	2.82	9640**	520
Beryllium	ug/L	1.12	39.5**	0.016cc/182n
Calcium	ug/L	105	330000**	N/A
Cobalt	ug/L	25	477**	2200
Chromium	ug/L	16.8	481**	180
Copper	ug/L	18.8	427**	1500
Iron	ug/L	77.5	408000**	11000
Potassium	ug/L	1240	16600**	N/A
Magnesium	ug/L	135	162000**	N/A
Manganese	ug/L	9.67	18000**	180
Sodium	ug/L	279	35700**	N/A
Nickel	ug/L	32.1	610**	730
Thallium	ug/L	2.44	16.2**	2.9
Vanadium	ug/L	27.6	883**	260
Zinc	ug/L	18	1920**	11000

**Footnotes:**

\* - Data collected from chemical transfer file (Phase I)

\*\* - Data collected from USAEC Pyramid system (Phase III)

CRL - Certified reporting limit

ID - Identification

N/A - Not applicable

N/F - Analysis requested, not yet received

QC - Quality control

TICs - Tentatively Identified Compound: number of TICs (total value)

Boolean Codes

LT - Less than the certified reporting limit / method detection level

**Flagging Codes:**

I - Interference in sample make quantitation and/or identification to be suspect.

J - Value is estimated.

### 3.6.18.3 Streamlined Risk Assessment - Inside Sand Filter Beds

A streamlined risk assessment was conducted for current and future land uses at AREE 21 based on soil samples collected from inside the sand filter beds. Risks were calculated only for the soil ingestion pathway. As shown in Table 3-58, noncancer HIs did not exceed 1 and cancer risks did not exceed  $1 \times 10^{-4}$  for either the station or the construction worker. Under a residential land use scenario, noncancer HIs did not exceed 1 and cancer risks did not exceed  $1 \times 10^{-4}$  for either the child or adult receptor.

**Table 3-58. Risk Characterization Summary for Soil Ingestion  
for Inside the Sand Filter Beds (AREE 21)**

Current Land Use				Future Land Use			
Noncancer HI		Cancer Risk		Noncancer HI		Cancer Risk	
Station Worker	Construction Worker	Station Worker	Construction Worker	Resident Child	Resident Adult	Resident Child	Resident Adult
0.1	0.4	2E-06	1E-06	1	0.1	6E-06	3E-06

### 3.6.18.4 Streamlined Risk Assessment - Outside Sand Filter Beds

A streamlined risk assessment was conducted for current and future land uses at AREE 21 based on soil samples collected from outside the sand filter beds. Risks were calculated only for the soil ingestion pathway. As shown in Table 3-59, noncancer HIs did not exceed 1 and cancer risks did not exceed  $1 \times 10^{-4}$  for either the station or the construction worker. Under a residential land use scenario, noncancer HIs did not exceed 1 and cancer risks did not exceed  $1 \times 10^{-4}$  for either residential receptor.

**Table 3-59. Risk Characterization Summary for Soil Ingestion  
for Outside the Sand Filter Beds (AREE 21)**

Current Land Use				Future Land Use			
Noncancer HI		Cancer Risk		Noncancer HI		Cancer Risk	
Station Worker	Construction Worker	Station Worker	Construction Worker	Resident Child	Resident Adult	Resident Child	Resident Adult
0.1	0.5	5E-06	3E-06	1	0.1	1E-05	8E-06

### 3.6.18.5 Site Assessment

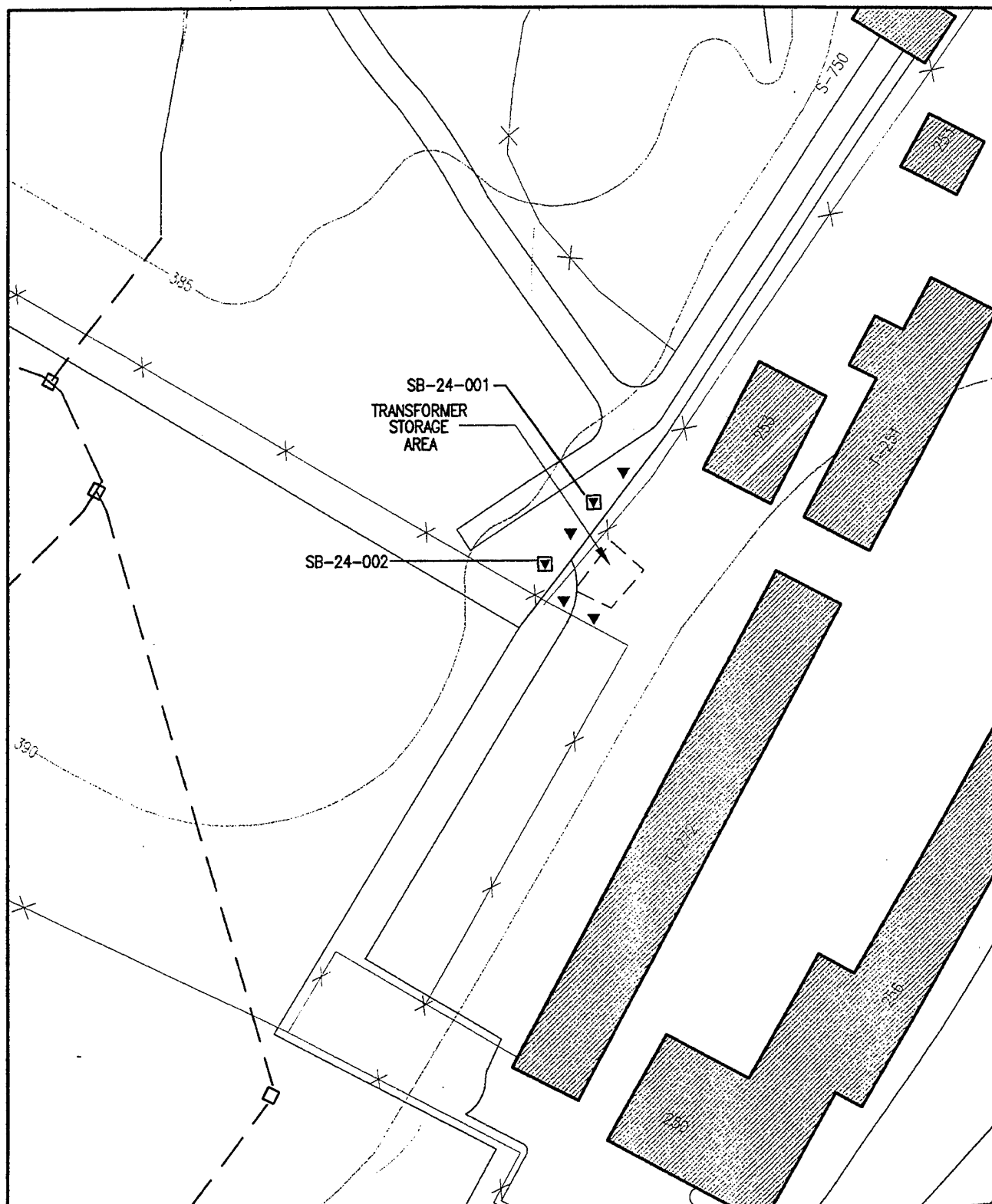
The concentration of metals in the soils inside the filter beds did not exceed the adjusted residential soil RBCs with the exception of arsenic and iron. The soils inside the filter beds were filter sands, and thus, were not compared to background or regional concentrations. The concentrations of metals in the soils outside the filter beds did not exceed the adjusted residential soil RBCs with the exception of aluminum, arsenic, beryllium, iron, and vanadium. All of these concentrations were within background or regional concentrations. Results from the streamlined risk assessment indicated that risks at AREE 21 for the soil ingestion pathway do not exceed EPA target levels under current or future land use scenarios. No further investigations are recommended for the soils at the filter beds.

In general, the detected concentrations of arsenic, beryllium, and manganese in the downgradient wells (GW07W, MW-21-002, and MW-21-003) were higher than the adjusted tap water RBCs and the concentrations in the upgradient well (MW-21-001). The exception to this is that the manganese concentration in the sample from MW-21-002 is lower than both the RBC and the concentration in the sample from the upgradient well. However, all of these concentrations are below drinking water MCLs. Soil sampling within the Sand Filter Bed absorption field is recommended to determine if this area is the source of the elevated metals concentrations. An additional round of groundwater sampling also is recommended.

### 3.6.19 AREE 24 - Transformer Storage Area

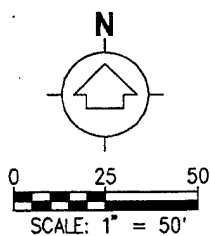
The Transformer Storage Area was used to store PCB transformers and PCB-contaminated transformers prior to their removal. This area also may have been used to store drums containing oil and fuel filters. Sampling at this AREE consisted of collecting surface soil samples from six locations and screening the samples onsite for PCBs using a field screening test kit. Two of the six surface soil samples were sent to the laboratory for analysis for metals, pesticides, PCBs, and TPH. Figure 3-25 shows the locations of the screening and laboratory surface soil samples.





**LEGEND:**

- .....BUILDING
- .....FENCE
- .....ROAD
- .....PCB SCREENING SAMPLE
- .....SCREENING & SURFACE SOIL SAMPLE



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**AREA 24 - TRANSFORMER STORAGE AREA**

Figure: 3-25	Project: 01-0827-03-6521-060	File Name: /95005/DWGS/036AR10C	Date: 03-28-95
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### 3.6.19.1 Surface Soil Results

Field PCB screening conducted on samples from six locations at this AREE did not detect PCBs at concentrations higher than the detection limit of 1 ppm. Consequently, two samples from this AREE were selected randomly for laboratory analysis. The results of the laboratory analyses for the Transformer Storage Area are provided in Appendix J. Table 3-60 provides the results and RBCs for those analytes detected above the CRL. Five metals (arsenic, aluminum, beryllium, iron, and vanadium) detected in the soils at the Transformer Storage Area exceeded their adjusted residential soil RBCs. As shown in Table 3-61, aluminum, beryllium, iron, and vanadium were below background concentrations and arsenic exceeded background because it was not detected in background samples. However, the concentration of arsenic detected in the sample from location SS-24-001 is within two standard deviations of the regional average for arsenic (see Table 3-5).

The pesticide endosulfan sulfate was detected at low concentrations well below protection standards in both surface soil samples taken at the Transformer Storage Area. The RBC for endosulfan, of which endosulfan sulfate is a derivative, was used for comparison because no RBC exists for endosulfan. The pesticide 2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane (p,p'-DDT) also was detected at a low concentration well below protection standards in the sample from location SS-24-002. Historical use of these pesticides at the facility would account for the small amount of residual in the soils. TPH was detected in the samples from both locations at concentrations below the state action level of 100 ppm. No PCBs were detected in the samples taken from this AREE.

### 3.6.19.2 Streamlined Risk Assessment

A streamlined risk assessment was conducted for current and future land uses at AREE 24. Risks were calculated only for the soil ingestion pathway. As shown in Table 3-62, noncancer HIs did not exceed 1 and cancer risks did not exceed  $1 \times 10^{-4}$  for either the station or the construction worker. Under a residential land use scenario, noncancer HIs did not exceed 1 and cancer risks did not exceed  $1 \times 10^{-4}$  for either residential receptor.

**Table 3-60. Data Summary Table: Soil - Transformer Storage Area (AREE 24)  
Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SS-24-001	SS-24-002	Residential RBCs (EPA 1996)	Adjusted RBCs
Field Sample Number	SAIC01	SAIC01		
Site Type	SURF	SURF		
Collection Date	11/7/94	11/7/94		
Depth (ft)	0	0		
Associated Field QC Sample - Site ID				
Associated Field QC Sample - Field Sample No.				
Associated Field QC Sample - Site ID				
Associated Field QC Sample - Field Sample No.				
<b>METALS/SOIL/CAA (Y9) (ug/g)</b>				
Laboratory ID Number	UB06167	UB06168		
Parameter	Units	CRL	LT	0.05**
Mercury	ug/g	0.05		23
<b>METALS/SOIL/GFAA (B9, JD20, JD21) (ug/g)</b>				
Laboratory ID Number	UB06167	UB06168		
Parameter	Units	CRL	LT	2.5**
Arsenic	ug/g	2.5		0.43c/23n
Lead	ug/g	0.467		N/A
<b>METALS/SOIL/ICP (JS12) (ug/g)</b>				
Laboratory ID Number	UB06167	UB06168		
Parameter	Units	CRL		
Aluminum	ug/g	11.2		78000
Barium	ug/g	3.29		5500
Beryllium	ug/g	0.427		116**
Calcium	ug/g	25.3		1.19**
Cobalt	ug/g	2.5		2870**
Chromium	ug/g	1.04		15.9**
Copper	ug/g	2.84		4700
Iron	ug/g	6.66		29.1**
Potassium	ug/g	131		390
Magnesium	ug/g	10.1		3100
Manganese	ug/g	9.87		23000
Sodium	ug/g	38.7		N/A
Nickel	ug/g	2.74		N/A
Vanadium	ug/g	1.14		10950
Zinc	ug/g	2.34		1600
<b>PESTICIDES/SOIL/GCEC (LH17) (ug/g)</b>				
Laboratory ID Number	UB06167	UB06168		
Parameter	Units	CRL		
Endosulfan Sulfate	ug/g	5E-04		470**
2,2-bis(p-Chlorophenyl)-1,1,1-trichloroethane	ug/g	0.004		1.9
		LT	0.0035**	0.00892** C

**Table 3-60. Data Summary Table: Soil - Transformer Storage Area (AREE 24)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	SS-24-001	SS-24-002	Residential RBCs (EPA 1996)	Adjusted RBCs
Field Sample Number	SAIC01	SAIC01		
Site Type	SURF	SURF		
Collection Date	11/7/94	11/7/94		
Depth (ft)	0	0		
Associated Field QC Sample - Site ID				
Associated Field QC Sample - Field Sample No.				
Associated Field QC Sample - Site ID				
Associated Field QC Sample - Field Sample No.				
<b>TRPH/SOIL (EPA 418.1) (ug/g)</b>				
Laboratory ID Number	UB06167	UB06168		
Parameter	Units	CRL		
Total Petroleum Hydrocarbons	ug/g	10	32.7**	57**
				N/A

**Footnotes:**

- \* - Data collected from chemical transfer file (Phase I)
- \*\* - Data collected from USAEC Pyramid system (Phase III)
- \*\*\* - RBC for Endosulfan
- CRL - Certified reporting limit
- ID - Identification
- N/A - Not applicable
- QC - Quality control
- TICs - Tentatively Identified Compound: number of TICs (total value)
- c - Carcinogenic effects.
- n - Noncarcinogenic effects.
- Boolean Codes
- LT - Less than the certified reporting limit / method detection level
- Flagging Codes
- C - Analysis was confirmed.
- Z - Non-target compound analyzed for and detected (non-GC/MS methods).

**Table 3-61. Background Soil Comparison-Transformer Storage Area (AREE 24)  
Vint Hill Farms Station, Warrenton, Virginia**

Substance	AREE 24 SOIL					Differs from Background?
	P,t,s	P,t,p	P,m-w	UTL (ppm)	% > UTL	Upper Tail (UTL test)
Aluminum	-	-	-	60600.00	0%	no
Arsenic	-	-	-	-	-	yes; NDB
Barium	-	-	-	-	-	-
Beryllium	-	-	-	5.10	0%	no
Cadmium	-	-	-	-	-	-
Calcium	-	-	-	-	-	-
Chromium	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-
Copper	-	-	-	-	-	-
Iron	-	-	-	180000.00	0%	no
Lead	-	-	-	-	-	-
Magnesium	-	-	-	-	-	-
Manganese	-	-	-	-	-	-
Mercury	-	-	-	-	-	-
Nickel	-	-	-	-	-	-
Potassium	-	-	-	-	-	-
Selenium	-	-	-	-	-	-
Silver	-	-	-	-	-	-
Sodium	-	-	-	-	-	-
Thallium	-	-	-	-	-	-
Vanadium	-	-	-	531.000	0%	no
Zinc	-	-	-	-	-	-

**Notes:**

P,t,s - t-test type I error probability assuming separate (or unequal) variances

P,t,p - t-test type I error probability assuming pooled (or equal) variances

P,m-w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples

**Table 3-62. Risk Characterization Summary for  
Soil Ingestion at the Transformer Storage Area (AREE 24)**

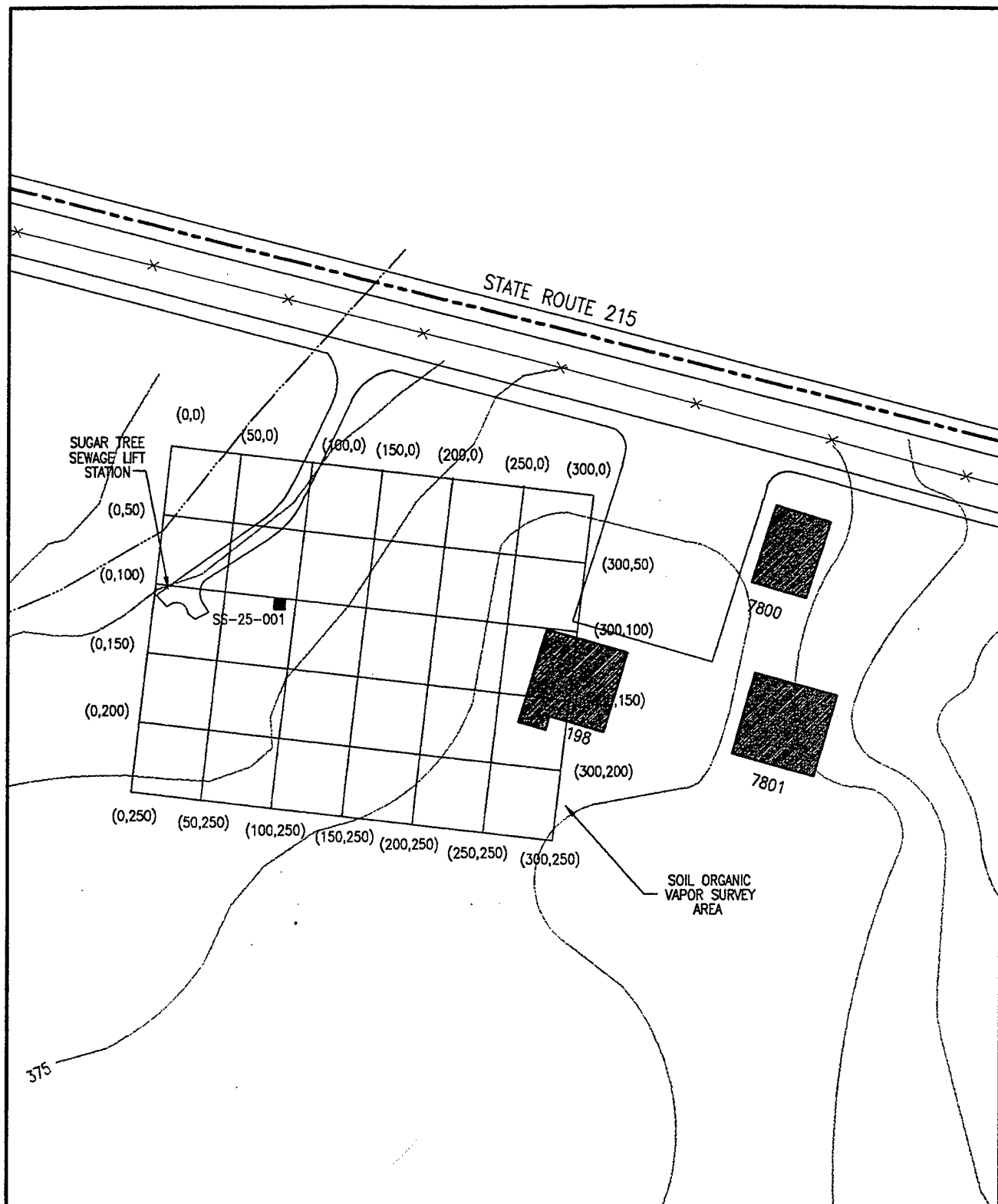
Current Land Use				Future Land Use			
Noncancer HI		Cancer Risk		Noncancer HI		Cancer Risk	
Station Worker	Construction Worker	Station Worker	Construction Worker	Resident Child	Resident Adult	Resident Child	Resident Adult
0.1	0.5	4E-06	2E-06	1	0.1	1E-05	6E-06

### 3.6.19.3 Site Assessment


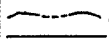
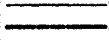



Soil sampling results from the Transformer Storage Area do not indicate significant environmental contamination. Five metals (arsenic, aluminum, beryllium, iron, and vanadium) were detected above their adjusted residential soil RBCs, but were within background concentrations or regional averages. Although site history indicates that PCBs would be the primary concern at this AREE, no PCBs were detected. In addition, none of the chemicals detected at this AREE is present at a concentration that would indicate significant contamination. The streamlined risk assessment results for the AREE 24 soil ingestion pathway do not exceed EPA target levels under current or future land use scenarios. Therefore, no further action at this AREE is recommended.

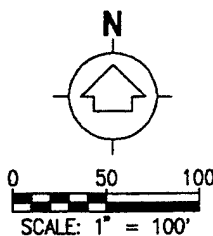
### 3.6.20 AREE 25 - Sugar Tree

Sugar Tree was investigated because small amounts of paint and solvents may have been disposed of at this location. Activities at Sugar Tree included screening the sites through the use of an SOV survey. During the initial SOV survey, 49 soil samples were collected and screened with a photoionization detector (PID), as described in Section 2.2.5.1. Four of these samples also were screened with the onsite GC. Four samples were collected from a nearby uncontaminated area for background PID readings. Two of these samples also were screened with the onsite GC. One surface soil sample was collected for laboratory analysis in the area at Sugar Tree that had the highest GC reading (grid coordinates 94', 101' on Figure 3-26). Because the location with the highest GC reading was a former diesel fuel aboveground storage tank (AST) location, the target compound was TPH. TPH was analyzed by EPA Method SW8015 in order to provide fractions of gasoline and diesel. Fourteen soil samples also were



# **LEGEND:**

-  BUILDING
-  SITE DRAINAGE
-  PAVED ROAD
-  SITE DRAINAGE
-  PAVED ROAD
-  SURFACE SOIL SAMPLE



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## **AREE 25 - SUGAR TREE SOV SURVEY GRID**

Figure: 3-26	Project: 01-0827-03-6521-061	File Name: 95005\DWGS\0363-12B	Date: 05-19-95
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collected and screened with a PID in a followup investigation in the area near the antenna field (grid coordinates 200', 250'). Figure 3-26 shows the location of the SOV survey grid and the surface soil sample.

#### **3.6.20.1 SOV Survey Results**

The results from the initial PID survey for those points with readings above 0 ppm are provided in Table 3-63. Figure 3-27 provides a map with non-zero PID readings at the appropriate locations. A PID reading of 22.3 ppm was detected near the antenna field at coordinates 200', 250'. A small (5 by 5 feet), localized area of contamination was found just east of the gravel drive (near coordinates 94', 101'). The PID reading at this location was 15.3 ppm. This area is the probable former location of the diesel AST that was used temporarily during the sewage lift station construction. The results from the onsite GC analysis are provided in both Table 3-64 and Appendix C. No VOCs were detected by the GC in either of the two background samples or from three of the four soil samples collected from Sugar Tree. However, total flame ionization detector (FID) volatiles were detected at location 94', 101' at a concentration of 44 parts per billion (ppb). A surface soil sample was collected at this location for confirmatory laboratory analysis.

The results of the followup investigation at the antenna field are shown in Table 3-65. Figure 3-28 provides a map with non-zero PID readings at the appropriate locations. Only one non-zero PID reading was detected at a concentration of 1.3 ppm. No samples were collected for confirmatory laboratory analysis due to the insignificant PID reading.

#### **3.6.20.2 Surface Soil Results**

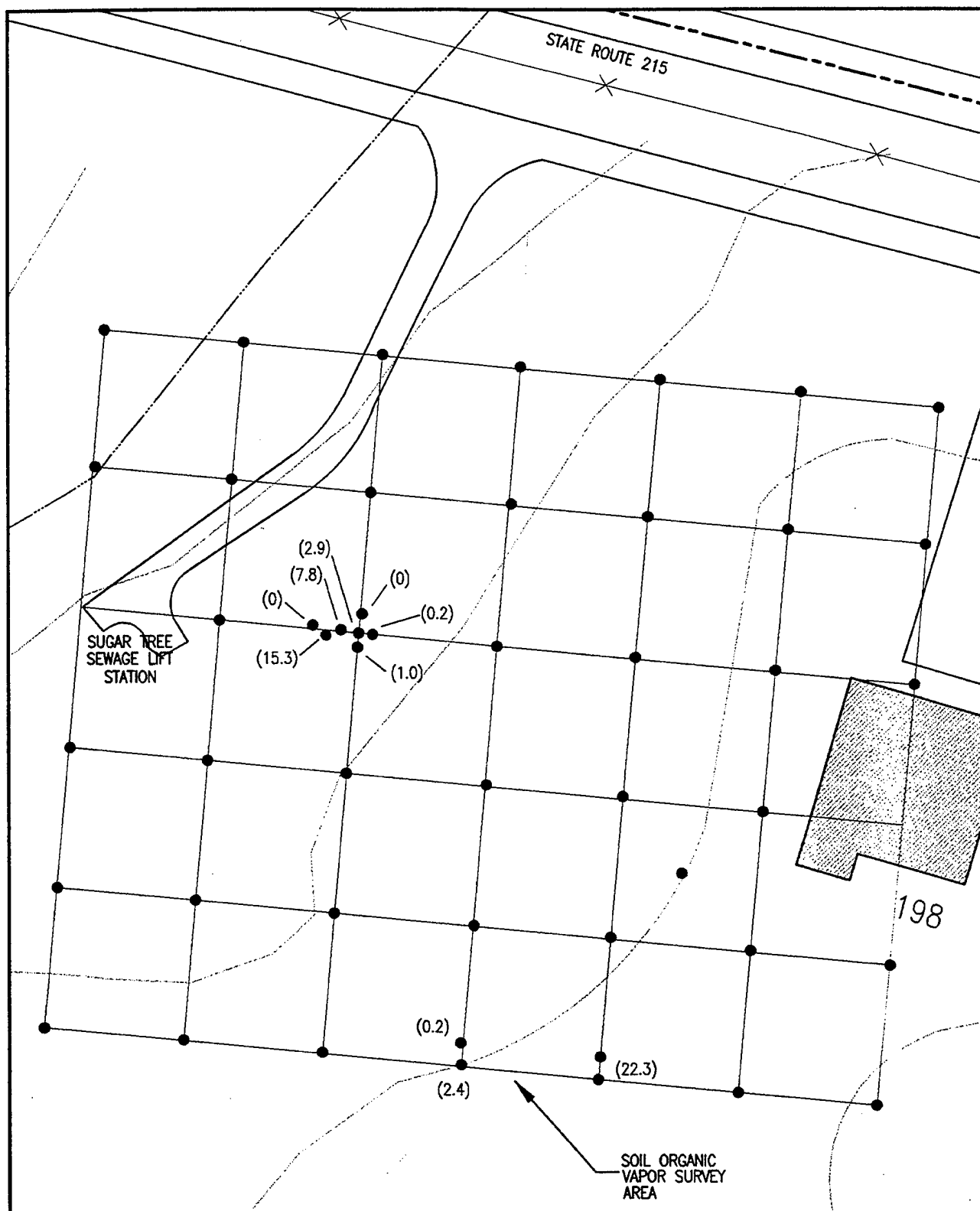
The results of the laboratory analyses for Sugar Tree are provided in Appendix J. Table 3-66 provides the results for TPH - diesel, which was detected at a concentration of 930  $\mu\text{g/g}$  in the duplicate sample taken at the location shown in Figure 3-26. TPH - diesel was not detected above the CRL in the primary environmental sample. TPH - gasoline was not detected in either the primary environmental sample or the duplicate sample taken at this AREE.



**Table 3-63. Initial PID Survey Results for AREE 25 - Sugar Tree  
Vint Hill Farms Station, Warrenton, Virginia**

(readings above 0 ppm)

Region	Coordinates	PID Reading (ppm)
Diesel AST Location	94', 101'	15.3
	95', 100'	7.8
	100', 100'	2.9
	100', 105'	1.0
	105', 100'	0.2
Near Antenna Fields	150', 245'	0.2
	150', 250'	2.4
	200', 250'	22.3

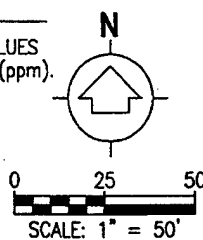


#### LEGEND.

- BUILDING
- SITE DRAINAGE
- PAVED ROAD
- SITE DRAINAGE
- PAVED ROAD
- SOV SURVEY POINT

#### LEGEND.

ALL SOV SURVEY VALUES  
NOT SHOWN ARE 0 (ppm).



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#### AREE 25 - SUGAR TREE PID RESULTS (ppm)

Figure: 3-27	Project: 01-0827-03-6521-061	File Name: 95005\DWGS\0363-12C	Date: 09-08-95
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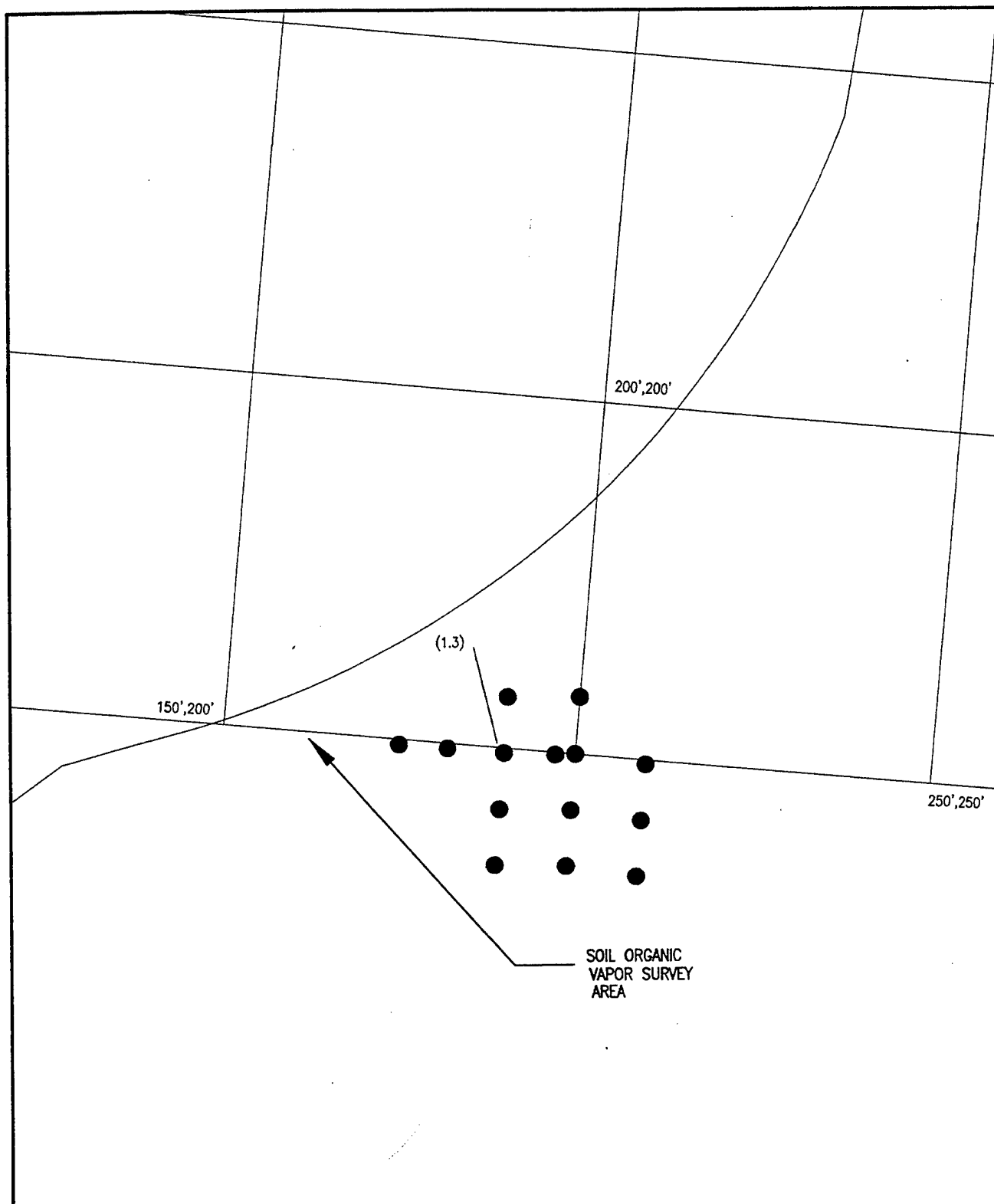
Table 3-64. GC Analysis Results for AREE 25 - Sugar Tree  
Vint Hill Farms Station, Warrenton, Virginia

Region	Coordinates	Volatile Organics					Chlorinated Organics				
		Benzene (ppb)	Toluene (ppb)	Ethylbenzene (ppb)	Xylenes (ppb)	Total FID Volatiles (ppb)	BrClMe (ppb)	111TCA (ppb)	CCl4 (ppb)	TCE (ppb)	PCE (ppb)
Diesel AST Location	94', 101'	< 1	< 1	< 1	< 1	44	< 1	< 1	< 1	< 1	< 1
Near Antenna Field	150', 245'	< 1	< 1	< 1	< 1	< 10	< 1	< 1	< 1	< 1	< 1
	200', 245'	< 1	< 1	< 1	< 1	< 10	< 1	< 1	< 1	< 1	< 1
Gasoline Can Storage	225', 175'	< 1	< 1	< 1	< 1	< 10	< 1	< 1	< 1	< 1	< 1
Background	BKGD 1	< 1	< 1	< 1	< 1	< 10	< 1	< 1	< 1	< 1	< 1
	BKGD 2	< 1	< 1	< 1	< 1	< 10	< 1	< 1	< 1	< 1	< 1

BrClMe - Bromochloromethane  
111TCA - 1,1,1-Trichloroethane  
CCl4 - Carbon Tetrachloride  
TCE - Trichloroethene  
PCE - Tetrachloroethene  
BKGD - Background

**Table 3-65. Followup PID Survey Results for AREE 25 - Sugar Tree  
Vint Hill Farms Station, Warrenton, Virginia**

Region	Coordinates	PID Reading (ppm)
Near Antenna Fields	175', 250'	ND
	194', 250'	ND
	195', 249'	ND
	195', 250'	1.3
	195', 251'	ND
	195', 260'	ND
	196', 250'	ND
	200', 245'	ND
	200', 250'	ND
	200', 255'	ND
	200', 260'	ND
	205', 250'	ND
	205', 255'	ND
	205', 260'	ND

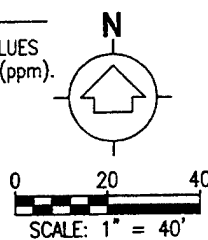


**LEGEND:**

.....PAVED ROAD  
 ●.....SOV SURVEY POINT

**LEGEND:**

ALL SOV SURVEY VALUES  
 NOT SHOWN ARE 0 (ppm).



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**AREE 25 - SUGAR TREE PID RESULTS (ppm)  
 SUPPLEMENTAL SURVEY**

Figure: 3-28	Project: 01-0827-03-6521-061	File Name: 95005/DWGS/249F3-28	Date: 10-04-95
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**Table 3-66. Data Summary Table: Soil - Sugar Tree (AREE 25)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SS-25-001	SS-25-001
Field Sample Number	SAIC01	SAIC02
Site Type	SURF	SURF
Collection Date	11/11/94	11/11/94
Depth (ft)	0	0

---

TPH/SOIL (CDHS) (ug/g)			
Laboratory ID Number		UB06240	UB06241
Parameter	Units	CRL	
Total Petroleum Hydrocarbons-Diesel	ug/g	10	
	LT	10** 9	
			930** D9

Footnotes:  
 \* - Data collected from chemical transfer file (Phase I)  
 \*\* - Data collected from USAEC Pyramid system (Phase III)  
 CRL - Certified reporting limit  
 ID - Identification  
 N/A - Not applicable  
 QC - Quality control  
 TICs - Tentatively Identified Compound: number of TICs (total value)  
 Boolean Codes  
 LT - Less than the certified reporting limit / method detection level  
 Flagging Codes  
 D - Duplicate analysis.  
 9 - Non-demonstrated / validated method performed for USAEC.

### 3.6.20.3 Site Assessment

Results from the PID survey conducted at Sugar Tree showed two areas of potential concern: the soils near the antenna field and near the gravel drive at the former AST location. However, the PID survey results from the area near the antenna field were not confirmed with the onsite GC. In addition, the followup PID survey in the area detected only one non-zero reading at a low, inconsequential level. Therefore, no further action is recommended for the soils near the antenna field.

The PID reading from the area near the gravel drive was confirmed by onsite GC analysis. In addition, TPH - diesel was detected at 930 ppm from the duplicate soil sample taken from this location, which was the prior location of the diesel AST. Because no visible negative impacts on the soil or vegetation surrounding the sample location were noted, it is likely that only a small area was contaminated by drips or spills from the AST. In addition, because the primary environmental sample was collected from an area within a few inches of the duplicate sample, the nondetect result indicates that the area of contamination is limited in its extent. Furthermore, numerous PID survey samples were collected in the immediate area of the former diesel AST and these results also indicate that the drip or spill area is contained within a small, localized area. The possibility of a spill of such a minute volume reaching the groundwater given the silty clay nature of the soils is considered minimal. Similarly, the possibility of this spill reaching surface water is considered minimal given the distance to the tributary (more than 50 feet). Because chances for migration are minimal and because the minute amount of diesel fuel present will naturally biodegrade, no further action is recommended at Sugar Tree. However, EPA has requested additional soil samples and a groundwater sample to further characterize this AREE.

### 3.6.21 AREE 26 - Outdoor Wash Racks

The Outdoor Wash Racks area includes two locations of automobile wash areas: one former location southeast of Building 161, and the current location southwest of Building 161. Sampling at this AREE consisted of collecting two surface soil samples from the former wash racks location and four surface soil samples from the current wash racks location. The locations at the current wash racks were chosen based on their proximity to the grit chamber and the area

where overflow from the racks discharges. Figure 3-29 shows the locations of the surface soil samples at the Outdoor Wash Racks. The target compounds at this AREE were metals, VOCs, SVOCs, and TPH.

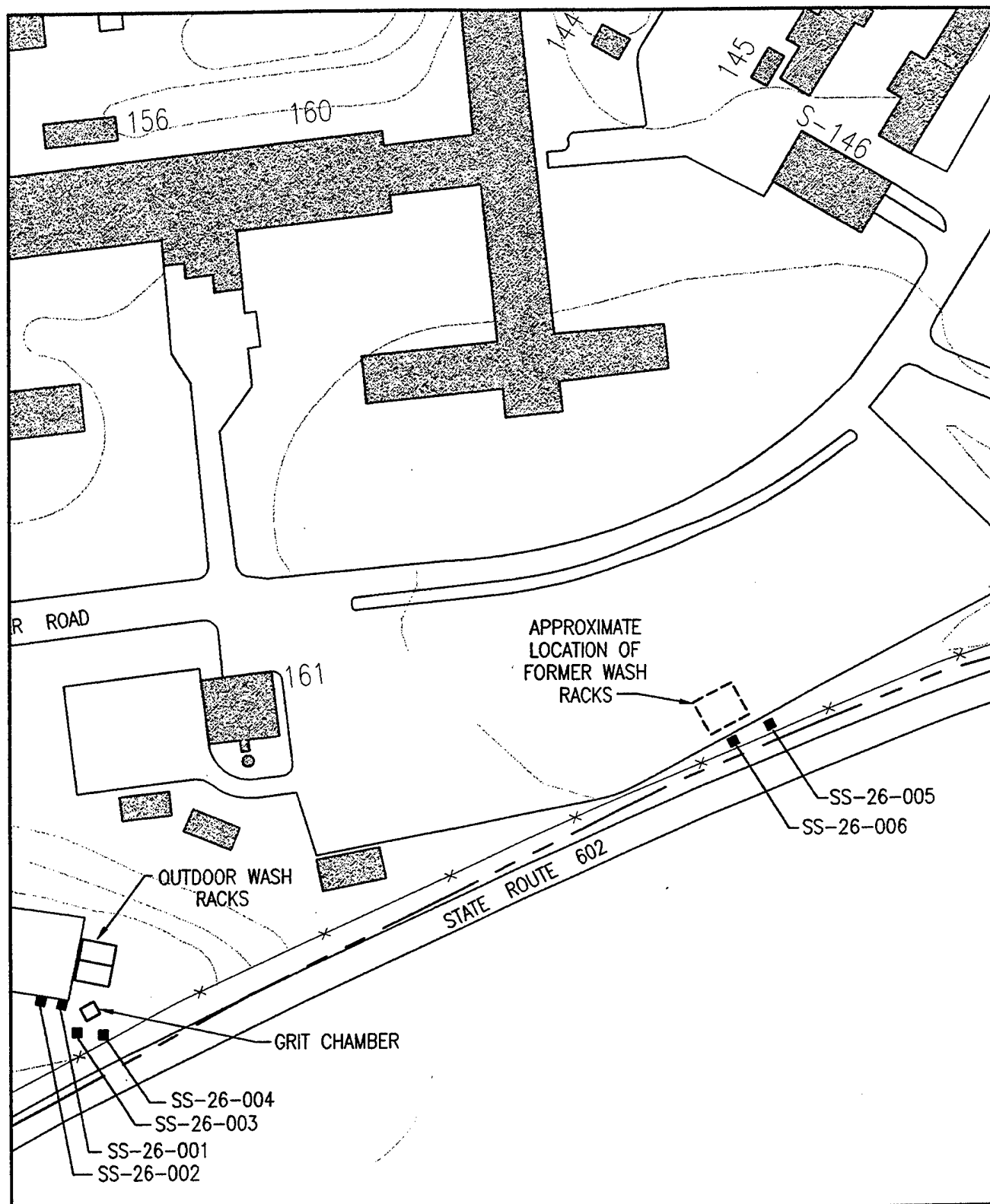
#### 3.6.21.1 Surface Soil Results

The results of the laboratory analyses for the Outdoor Wash Racks are provided in Appendix J. Table 3-67 provides the results and RBCs for those contaminants detected above the CRL. Three metals (aluminum, beryllium, and iron) were detected at the former wash rack location above their adjusted residential soil RBCs. As shown in Table 3-68, all three metals are below background concentrations according to the UTL test. No VOCs, SVOCs, or TPH were detected in the two surface soil samples taken from the former wash rack location.

As indicated in Table 3-67, five metals (arsenic, aluminum, beryllium, iron, and vanadium) were detected at the current wash rack locations above their adjusted residential soil RBCs. As shown in Table 3-68, aluminum, beryllium, iron, and vanadium were within background concentrations according to the t-test and UTL test, while arsenic exceeded background because it was not detected in the background samples. However, the maximum detection of arsenic ( $4.27 \mu\text{g/g}$ ) was below the regional average of  $4.8 \mu\text{g/g}$  for arsenic.

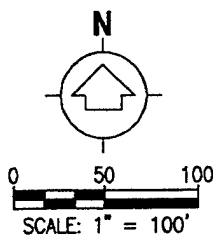
No VOCs were detected in any of the surface soil samples taken from the current wash rack location. SVOCs were detected in three of the surface soil samples taken from the current wash rack location. The detected SVOCs include acenaphthene, benzo(a)anthracene, chrysene, dimethyl phthalate, di-n-butyl phthalate, fluoranthene, phenanthrene, and pyrene. The SVOCs detected in the soils surrounding the current wash racks location are predominantly those found in coal tar, the distillation of which produces road tar, oils, and other coal-tar aromatics. Benzo(a)anthracene, chrysene, fluoranthene, phenanthrene, and pyrene are all coal tar constituents. Acenaphthene is found in petroleum residues. Dimethyl phthalate is a solvent, and also is found in insect repellents. Di-n-butyl phthalate is also an insect repellent. These compounds (with the exception of phenanthrene) were detected at concentrations significantly less than the residential RBCs (up to 400 times less for acenaphthene, chrysene, dimethyl phthalate, di-n-butyl phthalate, fluoranthene, and pyrene). Although there is no RBC for





# **LEGEND:**

	BUILDING
	ROAD
	FENCE
	SITE BOUNDARY
	SURFACE SOIL SAMPLE



**SAIC**  
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**VINT HILL FARMS STATION  
WARRENTON, VIRGINIA  
SI REPORT**

## **AREE 26 - OUTDOOR WASH RACKS**

Figure: 3-29	Project: 01-0827-03-6521-061	File Name: /95005/DWGS/036AR28A	Date: 09-08-95
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**Table 3-67. Data Summary Table: Soil - Outdoor Wash Racks (AREE 26)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SS-26-001	SS-26-002	SS-26-003	SS-26-004
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01
Site Type	SURF	SURF	SURF	SURF
Collection Date	11/11/94	11/11/94	11/11/94	11/11/94
Depth (ft)	0	0	0	0

<b>METALS/SOIL/GFAA (B9, JD20, JD21) (ug/g)</b>				
Laboratory ID Number	UB06244	UB06245	UB06246	UB06247
Parameter	Units	CRL		
Arsenic	ug/g	2.5	LT	2.5**
Lead	ug/g	0.467	29**	17.7**

<b>METALS/SOIL/ICP (JS12) (ug/g)</b>				
Laboratory ID Number	UB06244	UB06245	UB06246	UB06247
Parameter	Units	CRL		
Aluminum	ug/g	11.2	26600**	33200**
Barium	ug/g	3.29	74.4**	87.3**
Beryllium	ug/g	0.427	0.781**	0.949**
Calcium	ug/g	25.3	1750**	2050**
Cobalt	ug/g	2.5	30.2**	28.4**
Chromium	ug/g	1.04	37.6**	32.1**
Copper	ug/g	2.84	25**	36.4**
Iron	ug/g	6.66	57700**	57200**
Potassium	ug/g	131	1390**	1400**
Magnesium	ug/g	10.1	1860**	2600**
Manganese	ug/g	9.87	656**	516**
Sodium	ug/g	38.7	101**	78.4**
Nickel	ug/g	2.74	11.3**	10.7**
Vanadium	ug/g	1.14	117**	136**
Zinc	ug/g	2.34	69.8**	70.8**

<b>SEMIVOLATILES/SOIL/GCMS (LM25) (ug/g)</b>				
Laboratory ID Number	UB06244	UB06245	UB06246	UB06247
Parameter	Units	CRL		
Acenaphthene	ug/g	0.041	LT	0.041**
Benzo(a)anthracene	ug/g	0.041	LT	0.041**
Chrysene	ug/g	0.032	0.091**	0.12**
Dimethyl Phthalate	ug/g	0.063	LT	0.063**
di-N-Butyl Phthalate	ug/g	1.3	2.2**	1.3**
Fluoranthene	ug/g	0.032	0.093**	0.062**
Phenanthrene	ug/g	0.032	0.12**	0.032**

**Table 3-67. Data Summary Table: Soil - Outdoor Wash Racks (AREE 26)**  
**Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	SS-26-001	SS-26-001	SS-26-002	SS-26-003	SS-26-004
Field Sample Number	SAIC01	SAIC02	SAIC01	SAIC01	SAIC01
Site Type	SURF	SURF	SURF	SURF	SURF
Collection Date	11/11/94	11/11/94	11/11/94	11/11/94	11/11/94
Depth (ft)	0	0	0	0	0
Pyrene					
TICs	ug/g	ug/g	ug/g	ug/g	ug/g
	0.083	0.083**	0.083**	0.083**	0.083**
	LT	LT	LT	LT	LT
	32 (28.8)	29 (51.4)	12 (20.1)	20 (30.2)	4 (2.0)
<b>TPH/SOIL (EPA 418.1) (ug/g)</b>					
Laboratory ID Number	UB06244	UB06245	UB06246	UB06247	UB06248
Parameter	Units	Units	Units	Units	Units
Total Petroleum Hydrocarbons	CRL	CRL	CRL	CRL	CRL
	ug/g	ug/g	ug/g	ug/g	ug/g
	10	110**	23.4**	10**	10**
		111** D			

**Table 3-67. Data Summary Table: Soil - Outdoor Wash Racks (AREE 26)**  
**Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	SS-28-005	SS-28-006	Residential RBCs	Adjusted RBCs
Field Sample Number	SAIC01	SAIC01	(EPA 1996)	
Site Type	SURF	SURF		
Collection Date	11/11/94	11/11/94		
Depth (ft)	0	0		

<b>METALS/SOIL/GFAA (B6, JD20, JD21) (ug/g)</b>				
Laboratory ID Number	Units	CRL		
Parameter	ug/g	LT	LT	2.5**
Arsenic	ug/g	0.467	0.43c/23n	16.5**
Lead			N/A	4.6n

<b>METALS/SOIL/ICP (JS12) (ug/g)</b>				
Laboratory ID Number	Units	CRL		
Parameter	ug/g	LT	LT	28400**
Aluminum	ug/g	11.2	15000**	58.6**
Barium	ug/g	3.29	57.2**	0.795**
Beryllium	ug/g	0.427	LT	1160**
Calcium	ug/g	25.3	2430**	4700
Cobalt	ug/g	2.5	6.83**	390
Chromium	ug/g	1.04	21**	3100
Copper	ug/g	2.84	9.61**	23000
Iron	ug/g	6.66	25700**	4600
Potassium	ug/g	131	528**	N/A
Magnesium	ug/g	10.1	1090**	N/A
Manganese	ug/g	9.87	156**	10950
Sodium	ug/g	38.7	106**	N/A
Nickel	ug/g	2.74	7.05**	1600
Vanadium	ug/g	1.14	60**	550
Zinc	ug/g	2.34	110**	23000

<b>SEMI-VOLATILES/SOIL/GCMS (LM25) (ug/g)</b>				
Laboratory ID Number	Units	CRL		
Parameter	ug/g	LT	LT	0.041**
Acenaphthene	ug/g	0.041	0.041**	4700
Benzo(a)anthracene	ug/g	0.041	0.041**	0.88
Chrysene	ug/g	0.032	0.032**	88
Dimethyl Phthalate	ug/g	0.063	0.063**	780000
di-N-Butyl Phthalate	ug/g	1.3	1.3**	7800
Fluoranthene	ug/g	0.032	0.032**	3100
Phenanthrene	ug/g	0.032	0.032**	2300***

**Table 3-67. Data Summary Table: Soil - Outdoor Wash Racks (AREE 26)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	SS-26-005	SS-26-006	Residential RBCs (EPA 1996)	Adjusted RBCs
Field Sample Number	SAIC01	SAIC01		
Site Type	SURF	SURF		
Collection Date	11/11/94	11/11/94		
Depth (ft)	0	0		
<b>TPH/SOIL (EPA 418.1) (ug/g)</b>				
Laboratory ID Number	UB06242			
Parameter	Units	CRL		
Total Petroleum Hydrocarbons	ug/g	10	LT	10**
Pyrene	ug/g	0.083	LT	0.083**
TICs		10 (9.3)	K	19 (20.3)
			K	2300
				N/A
<b>TPH/SOIL (EPA 418.1) (ug/g)</b>				
Laboratory ID Number	UB06243			
Parameter	Units	CRL		
Total Petroleum Hydrocarbons	ug/g	10	LT	10**
				N/A

**Footnotes:**

- \* - Data collected from chemical transfer file (Phase I)
- \*\* - Data collected from USAEC Pyramid system (Phase III)
- \*\*\* RBC for pyrene, a chemically- similar compound.
- CRL - Certified reporting limit
- ID - Identification
- N/A - Not applicable
- QC - Quality control
- TICs - Tentatively Identified Compound: number of TICs (total value)
- c - Carcinogenic effects.
- n - Noncarcinogenic effects.
- Boolean Codes
- LT - Less than the certified reporting limit / method detection level
- Flagging Codes
- D - Duplicate analysis.
- Data Qualifiers
- K - Missed holding time for extraction and preparation.

Table 3-68. Background Soil Comparison-Outdoor Wash Racks (AREE 26)  
Vint Hill Farms Station, Warrenton, Virginia

Substance	AREE 26 SOIL (current wash racks)						AREE 26 SOIL (former wash racks)					
	Differs from Background? Central Tendency (t-test, MW test)						Differs from Background? Upper Tail (UTL test)					
	P.t.s	P.t.p	P.m.w	UTL (ppm)	% > UTL		P.t.s	P.t.p	P.m.w	UTL (ppm)	% > UTL	Upper Tail (UTL test)
Aluminum			0.201	60600.00	0%		-	-	-	60600.00	0%	no
Arsenic		-	-	-	-	yes, NDB	-	-	-	-	-	-
Barium		-	-	-	-	-	-	-	-	-	-	-
Beryllium		0.593	5.10	5.10	0%	no	-	-	-	5.10	0%	no
Cadmium		-	-	-	-	-	-	-	-	-	-	-
Calcium		-	-	-	-	-	-	-	-	-	-	-
Chromium		-	-	-	-	-	-	-	-	-	-	-
Cobalt		-	-	-	-	-	-	-	-	-	-	-
Copper		-	-	-	-	-	-	-	-	-	-	-
Iron		0.088	180000.00	180000.00	0%	no	-	-	-	180000.00	0%	no
Lead		-	-	-	-	-	-	-	-	-	-	-
Magnesium		-	-	-	-	-	-	-	-	-	-	-
Manganese		-	-	-	-	-	-	-	-	-	-	-
Mercury		-	-	-	-	-	-	-	-	-	-	-
Nickel		-	-	-	-	-	-	-	-	-	-	-
Potassium		-	-	-	-	-	-	-	-	-	-	-
Selenium		-	-	-	-	-	-	-	-	-	-	-
Silver		-	-	-	-	-	-	-	-	-	-	-
Sodium		-	-	-	-	-	-	-	-	-	-	-
Thallium		-	-	-	-	-	-	-	-	-	-	-
Vanadium		0.136	531.00	531.00	0%	no	-	-	-	-	-	-
Zinc		-	-	-	-	-	-	-	-	-	-	-

Notes:

P.t.s - t-test type I error probability assuming separate (or unequal) variances

P.t.p - t-test type I error probability assuming pooled (or equal) variances

P.m.w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples

phenanthrene, pyrene is chemically similar, and the RBC for pyrene can be used for evaluation of the phenanthrene data. The maximum detected concentration of phenanthrene is significantly less than the RBC for pyrene. TPH was detected in samples from the locations where runoff from the parking area and wash racks could overflow (SS-26-001 and SS-26-002) at concentrations of 23.4 ppm and 110 ppm (above the state action level for UST sites of 100 ppm).

### 3.6.21.2 Streamlined Risk Assessment - Former Wash Racks

A streamlined risk assessment was conducted for current and future land uses at AREE 26 based on samples collected from the former vehicle wash racks. Risks were calculated only for the soil ingestion pathway. As shown in Tale 3-69, noncancer HIs were below 1 and cancer risks were below  $1 \times 10^{-4}$  for both the station and construction workers. Under a residential land use scenario, noncancer HIs were below 1 and cancer risks were below  $1 \times 10^{-4}$  for both the child and adult receptors.

**Table 3-69. Risk Characterization Summary for Soil Ingestion at the Former Wash Racks (AREE 26)**

Current Land Use				Future Land Use			
Noncancer HI		Cancer Risk		Noncancer HI		Cancer Risk	
Station Worker	Construction Worker	Station Worker	Construction Worker	Resident Child	Resident Adult	Resident Child	Resident Adult
0.03	0.1	1E-06	7E-07	0.3	0.04	4E-06	2E-06

### 3.6.21.3 Streamlined Risk Assessment - Current Wash Racks

A streamlined risk assessment was conducted for current and future land uses at AREE 26 based on samples collected from the current vehicle wash racks. Risks were calculated only for the soil ingestion pathway. As shown in Table 3-70, noncancer HIs did not exceed 1 and cancer risks did not exceed  $1 \times 10^{-4}$  for either the station or the construction worker. Under a residential land use scenario, noncancer HIs did not exceed 1 and cancer risks did not exceed  $1 \times 10^{-4}$  for either the child or adult receptor.

**Table 3-70. Risk Characterization Summary for Soil Ingestion  
at the Current Wash Racks (AREE 26)**

Current Land Use				Future Land Use			
Noncancer HI		Cancer Risk		Noncancer HI		Cancer Risk	
Station Worker	Construction Worker	Station Worker	Construction Worker	Resident Child	Resident Adult	Resident Child	Resident Adult
0.07	0.4	4E-06	2E-06	1	0.1	1E-05	7E-06

#### **3.6.21.4 Site Assessment**

Metals above adjusted residential soil RBCs and background concentrations, VOCs, SVOCs, and TPH were not detected at the former wash rack location. The streamlined risk assessment results for the former wash rack for the soil ingestion pathway do not exceed EPA target levels under current or future land use scenarios. No evidence of significant contamination was found at the former wash rack location; therefore, no further action is recommended at this area.

Four sampling locations were selected at the current wash rack location in close proximity to the grit chamber and in areas where overflows from the racks would discharge if the drains to the grit chamber were clogged. These locations were biased to detect the maximum concentrations of target compounds, if contamination was present. No metals were detected in the soils at concentrations above adjusted residential soil RBCs and background concentrations with the exception of arsenic, which was within regional concentrations. In addition, SVOCs typical of automobile cleaning areas were detected in the soils at concentrations significantly less than the residential soil RBCs. The streamlined risk assessment results for the current wash rack location for the soil ingestion pathway do not exceed EPA target levels under current or future land use scenarios. Because of the risk assessment conclusions, no further investigation activities are recommended at the current wash rack location. However, this AREE is an active maintenance area, and it is recommended that the pollution abatement measures be upgraded. The grit chamber and the drains from the racks to the chamber should be cleaned and inspected for cracks and leaks. The berms around the racks should be inspected and upgraded as



necessary to prevent runoff from flowing to the adjacent grassy area. Continued proper operation and maintenance of the grit chamber and drains also is recommended.

### **3.6.22 AREE 27 - AAFES Service Station**

The Army, Air Force Exchange Service (AAFES) Service Station was constructed in 1969 to provide fuel and service for vehicles belonging to VHFS personnel. Investigations at this AREE consisted of collecting three surface soil samples from areas within the AREE with potential contamination. Samples were collected at the discharge point of the grit chamber, at the point of discharge of service bay runoff, and in the tire storage area. Figure 3-30 shows the locations of the surface soil samples at the AAFES Service Station. The target compounds at this AREE were metals, VOCs, SVOCs, and TPH.

#### **3.6.22.1 Surface Soil Results**

The results of the laboratory analyses for the AAFES Service Station are provided in Appendix J. Table 3-71 provides results and RBCs for those contaminants detected above the CRL. Seven metals (arsenic, aluminum, beryllium, cadmium, chromium, iron, and vanadium) exceeded the adjusted residential soil RBCs in at least one soil sample. As shown in Table 3-72, aluminum, beryllium, chromium, iron, and vanadium do not exceed background concentrations according to the UTL test. Arsenic and cadmium concentrations exceeded background because these metals were not detected in the background samples. Arsenic was detected at locations SS-27-001 and SS-27-002 at concentrations of 5.32  $\mu\text{g/g}$  and 6.44  $\mu\text{g/g}$ , respectively. These concentrations are within one standard deviation of the eastern United States average soil concentration (Shacklette and Boerngen 1984). Lead was detected at a maximum concentration of 1,200  $\mu\text{g/g}$ , which is three times higher than the EPA screening level for lead in residential soils (EPA 1994). The maximum concentrations of beryllium, cadmium, chromium, and lead all were detected at location SS-27-003 at the grit chamber outfall.

No VOCs were detected in any of the three samples taken at this AREE. SVOCs were detected in the samples from locations SS-27-001 (fluoranthene and pyrene) and SS-27-002 (diethyl phthalate). These SVOCs were present in the soils at concentrations less than the



**Table 3-71. Data Summary Table: Soil - AAFES Service Station (AREE 27)  
Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SS-27-001	SS-27-002	SS-27-003	Residential RBCs (EPA 1996)
Field Sample Number	SAIC01	SAIC01	SAIC01	
Site Type	SURF	SURF	SURF	
Collection Date	11/14/94	11/14/94	11/14/94	
Depth (ft)	0	0	0	

<b>METALS/SOIL/CAA (Y9) (ug/g)</b>			
Laboratory ID Number	UB06282	UB06284	UB06285
Parameter	CRL	LT	
Mercury	ug/g 0.05	0.0724**	0.908**
			23

<b>METALS/SOIL/GFAA (B9, JD20, JD21) (ug/g)</b>			
Laboratory ID Number	UB06282	UB06284	UB06285
Parameter	CRL		
Arsenic	ug/g 2.5	5.32**	6.44**
Lead	ug/g 0.467	26.8**	40**
			LT
			2.5**
			1200**
			0.43c/23n
			N/A
			3.3n

<b>METALS/SOIL/ICP (JS12) (ug/g)</b>			
Laboratory ID Number	UB06282	UB06284	UB06285
Parameter	CRL		
Aluminum	ug/g 11.2	29700**	34400**
Barium	ug/g 3.29	45.9**	47.3**
Beryllium	ug/g 0.427	LT	0.681**
Calcium	ug/g 25.3	1850**	7650**
Cadmium	ug/g 1.2	1.2**	14.2**
Cobalt	ug/g 2.5	4**	6.29**
Chromium	ug/g 1.04	42.4**	75.5**
Copper	ug/g 2.84	24.4**	332**
Iron	ug/g 6.66	62000**	55200**
Potassium	ug/g 131	570**	991**
Magnesium	ug/g 10.1	990**	3350**
Manganese	ug/g 9.87	109**	167**
Sodium	ug/g 38.7	204**	328**
Nickel	ug/g 2.74	9.09**	18.7**
Vanadium	ug/g 1.14	111**	56.3**
Zinc	ug/g 2.34	123**	695**
			78000
			5500
			0.15c/390n
			N/A
			78
			4700
			390
			3100
			23000
			N/A
			N/A
			10950
			N/A
			N/A
			1600
			550
			23000
			79

**Table 3-71. Data Summary Table: Soil - AAFES Service Station (AREE 27)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	SS-27-001	SS-27-001	SS-27-001	SS-27-002	SS-27-003	Residential RBCs (EPA 1996)
Field Sample Number	SAIC01	SAIC02	SAIC01	SAIC01	SAIC01	
Site Type	SURF	SURF	SURF	SURF	SURF	
Collection Date	11/14/94	11/14/94	11/14/94	11/14/94	11/14/94	
Depth (ft)	0	0	0	0	0	
<b>SEMI-VOLATILES/SOIL/GCMS (LM25) (ug/g)</b>						
Laboratory ID Number	UB06282	UB06283	UB06284	UB06285		
Parameter	Units	CRL				
Diethyl Phthalate	ug/g	0.24	LT	0.24**	LT	2**
Fluoranthene	ug/g	0.032	LT	0.032**	LT	0.3**
Pyrene	ug/g	0.083	LT	0.083**	LT	0.8**
TICs	ug/g			5 (3.4)	4 (18.0)	N/A
<b>TPH/SOIL (EPA 418.1) (ug/g)</b>						
Laboratory ID Number	UB06282	UB06283	UB06284	UB06285		
Parameter	Units	CRL				
Total Petroleum Hydrocarbons	ug/g	10	737**	320** D	LT 10**	2310**
						N/A

**Footnotes:**

- \* - Data collected from chemical transfer file (Phase I)
- \*\* - Data collected from USAEC Pyramid system (Phase III)
- CRL - Certified reporting limit
- ID - Identification
- N/A - Not applicable
- QC - Quality control
- TICs - Tentatively Identified Compound: number of TICs (total value)
- c - Carcinogenic effects
- n - Noncarcinogenic effects
- Boolean Codes
- LT - Less than the certified reporting limit / method detection level
- Flagging Codes
- D - Duplicate analysis.

**Table 3-72. Background Soil Comparison-AAFES Service Station (AREE 27)  
Vint Hill Farms Station, Warrenton, Virginia**

Substance	AREE 27 SOIL					Differs from Background?
	P,t,s	P,t,p	P,m-w	UTL (ppm)	% > UTL	Upper Tail (UTL test)
Aluminum	-	-	-	60600.00	0%	no
Arsenic	-	-	-	-	-	yes; NDB
Barium	-	-	-	-	-	-
Beryllium	-	-	-	5.10	0%	no
Cadmium	-	-	-	-	-	yes; NDB
Calcium	-	-	-	-	-	-
Chromium	-	-	-	75.60	0%	no
Cobalt	-	-	-	-	-	-
Copper	-	-	-	-	-	-
Iron	-	-	-	180000.00	0%	no
Lead	-	-	-	13.00	100%	yes
Magnesium	-	-	-	-	-	-
Manganese	-	-	-	-	-	-
Mercury	-	-	-	-	-	-
Nickel	-	-	-	-	-	-
Potassium	-	-	-	-	-	-
Selenium	-	-	-	-	-	-
Silver	-	-	-	-	-	-
Sodium	-	-	-	-	-	-
Thallium	-	-	-	-	-	-
Vanadium	-	-	-	531.00	0%	no
Zinc	-	-	-	-	-	-

**Notes:**

P,t,s - t-test type I error probability assuming separate (or unequal) variances

P,t,p - t-test type I error probability assuming pooled (or equal) variances

P,m-w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples

adjusted residential RBCs, which indicates that the contaminants are present at concentrations below the level of concern with respect to human health effects.

TPH was detected in the samples from locations SS-27-001 (737  $\mu\text{g/g}$ ) and SS-27-003 (2,310  $\mu\text{g/g}$ ). These concentrations are significantly higher than the 100 ppm state action level.

#### **3.6.22.2 Site Assessment**

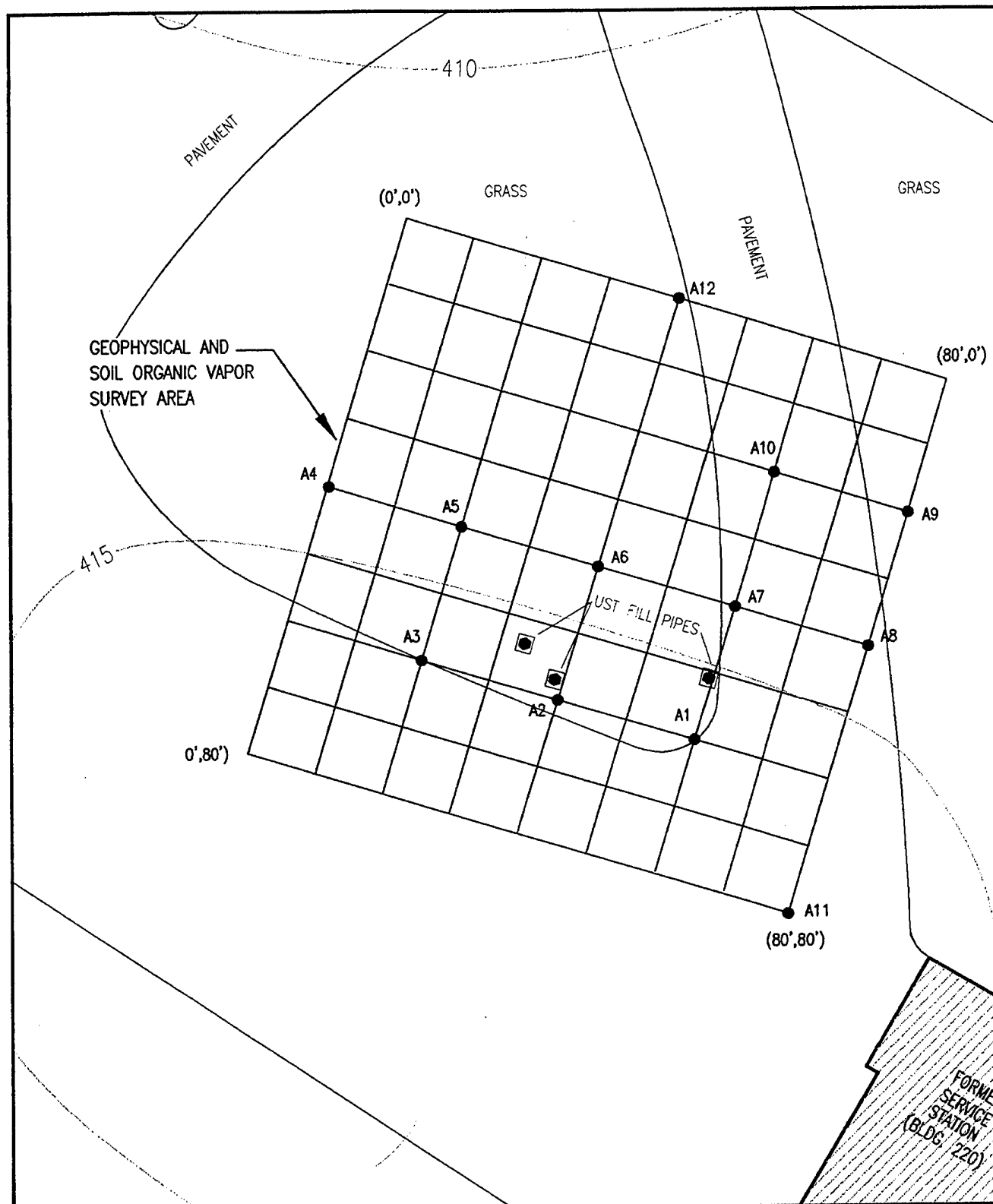
Seven metals (aluminum, arsenic, beryllium, cadmium, chromium, iron, and vanadium) were detected above the adjusted residential soil RBCs; all but cadmium were within background or regional concentrations. Lead was detected in the soils from the grit chamber outfall (SS-27-003) at a concentration three times higher than the EPA screening level. In addition, TPH was detected at concentrations significantly higher than the state action level. Additional investigation should be conducted to determine the full extent of soil contamination and the need for remediation of the soils.

#### **3.6.23 AREE 28-5 - Former Service Station Abandoned USTs**

The Former Service Station Abandoned USTs were located underneath the former service station parking lot. Three steel tanks were present at this AREE and were filled with gasoline and/or diesel fuel during their operational period. Activities at the Former Service Station Abandoned USTs included a geophysical survey, a soil gas survey, a soil sample screening survey, and sampling of four soil borings. Figure 3-31 shows the geophysical and SOV survey area. Figure 3-32 shows the soil sample screening locations. Figure 3-33 shows the locations of the soil borings at the AREE. The target compounds and analytes at this AREE were lead, VOCs, SVOCs, and TPH.

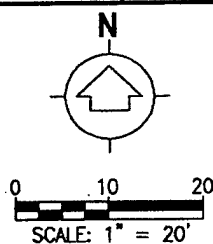
##### **3.6.23.1 Geophysical Survey Results**

The geophysical survey included EM and magnetic surveys over an 80- by 80-foot grid that was centered on the fill pipes. Figure 3-34 provides geophysical survey data for this AREE from the EM survey. Figure 3-35 provides magnetic survey results. Although the EM data collected at this AREE were affected by subsurface utilities, a location for the USTs could still

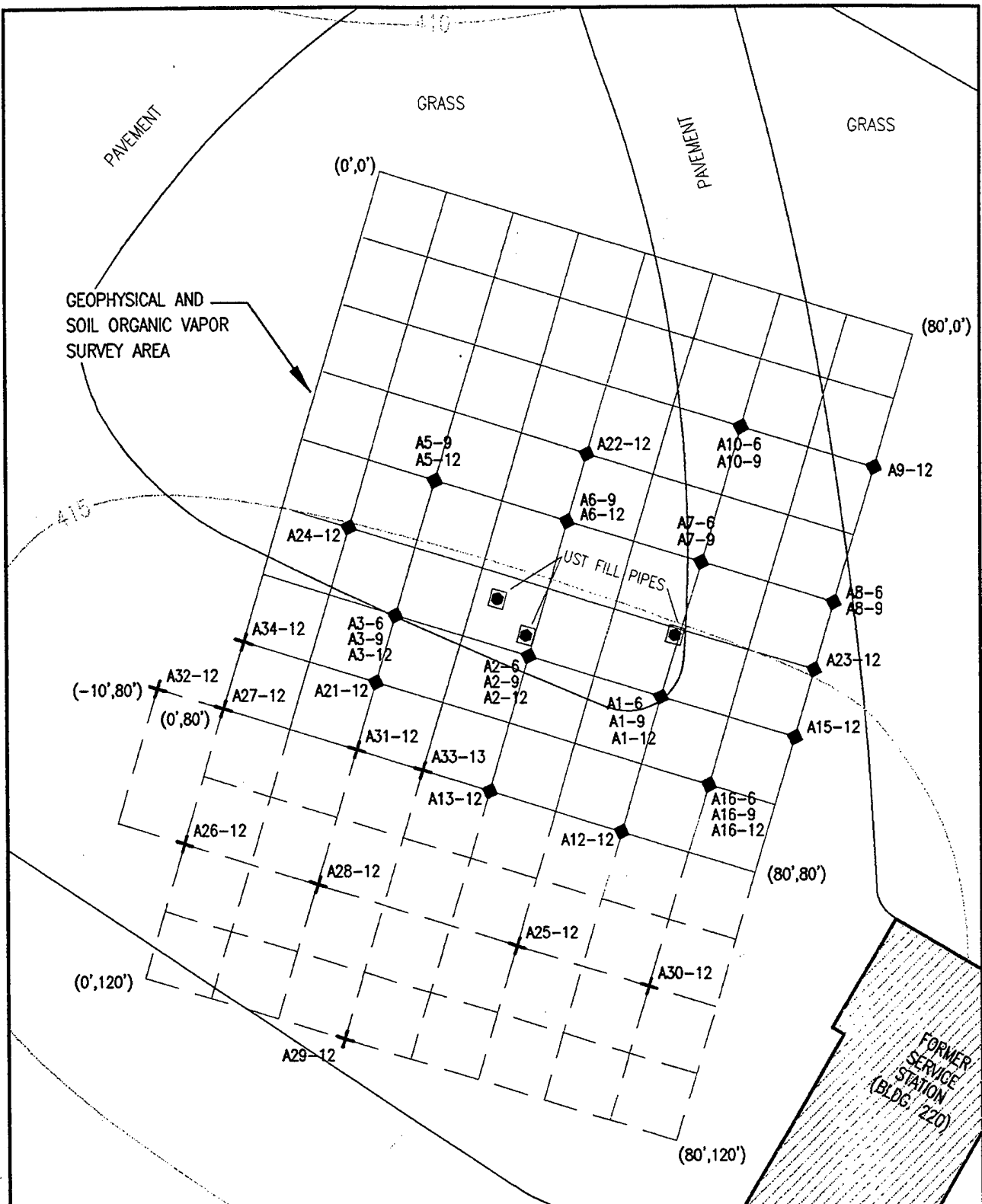


**LEGEND**

- ..... BUILDING
- ..... PAVED ROAD
- ..... UST FILL PIPE
- ..... SOV SAMPLE POINT
- ..... SURFACE CONTOUR

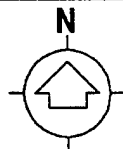


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<b>AREE 28-5 - FORMER SERVICE STATION</b> <b>GEOPHYSICAL AND SOV SURVEY</b>			
Figure:	Project:	File Name:	Date:
3-31	01-0827-03-6521-062	/95005/DWGS/036F317C	09-08-95



**LEGEND:**

- BUILDING
- PAVED ROAD
- UST FILL PIPE
- SCREENING SOIL SAMPLE (SEPTEMBER 1994)
- SCREENING SOIL SAMPLE (NOVEMBER 1994)
- SURFACE CONTOUR



0 10 20  
SCALE: 1" = 20'



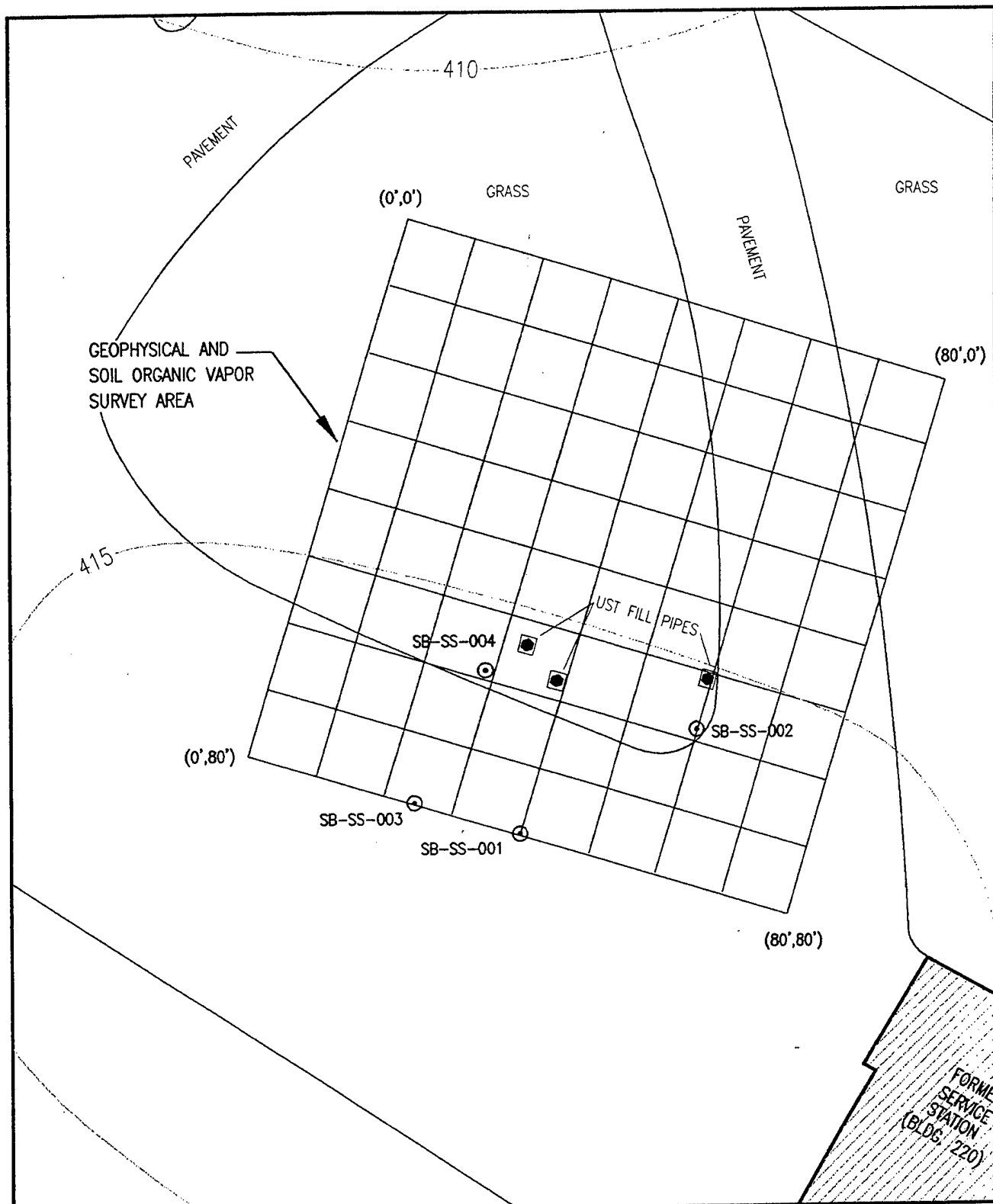
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



**AREE 28-5 - FORMER SERVICE STATION  
SCREENING SOIL SAMPLES**

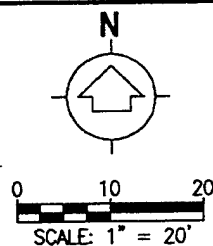
Figure: 3-32	Project: 01-0827-03-6521-062	File Name: /95005/DWGS/036F317D	Date: 09-08-95
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**LEGEND:**

-  ..... BUILDING
-  ..... PAVED ROAD
-  ..... UST FILL PIPE
-  ..... SURFACE CONTOUR
-  ..... SOIL BORING

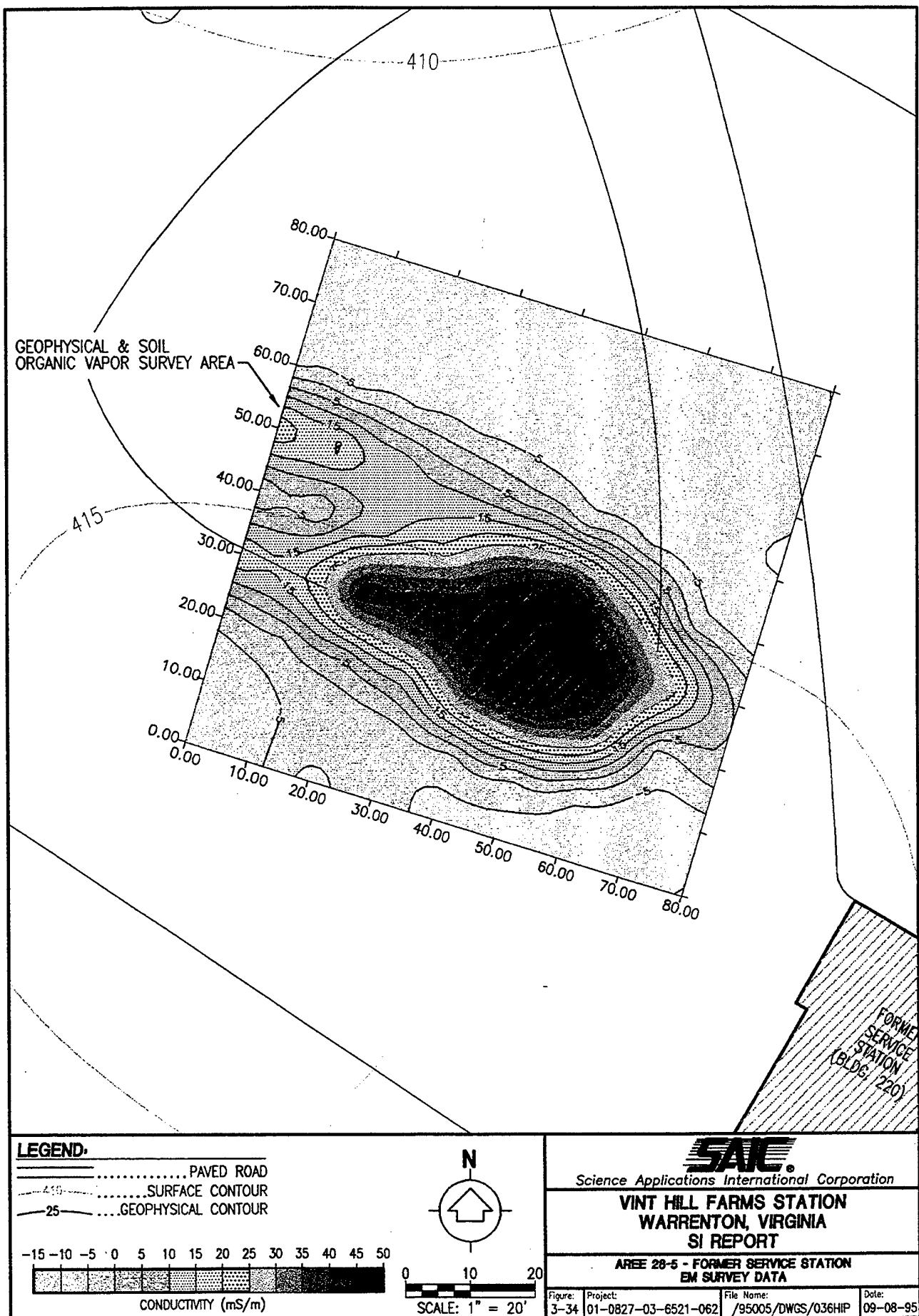


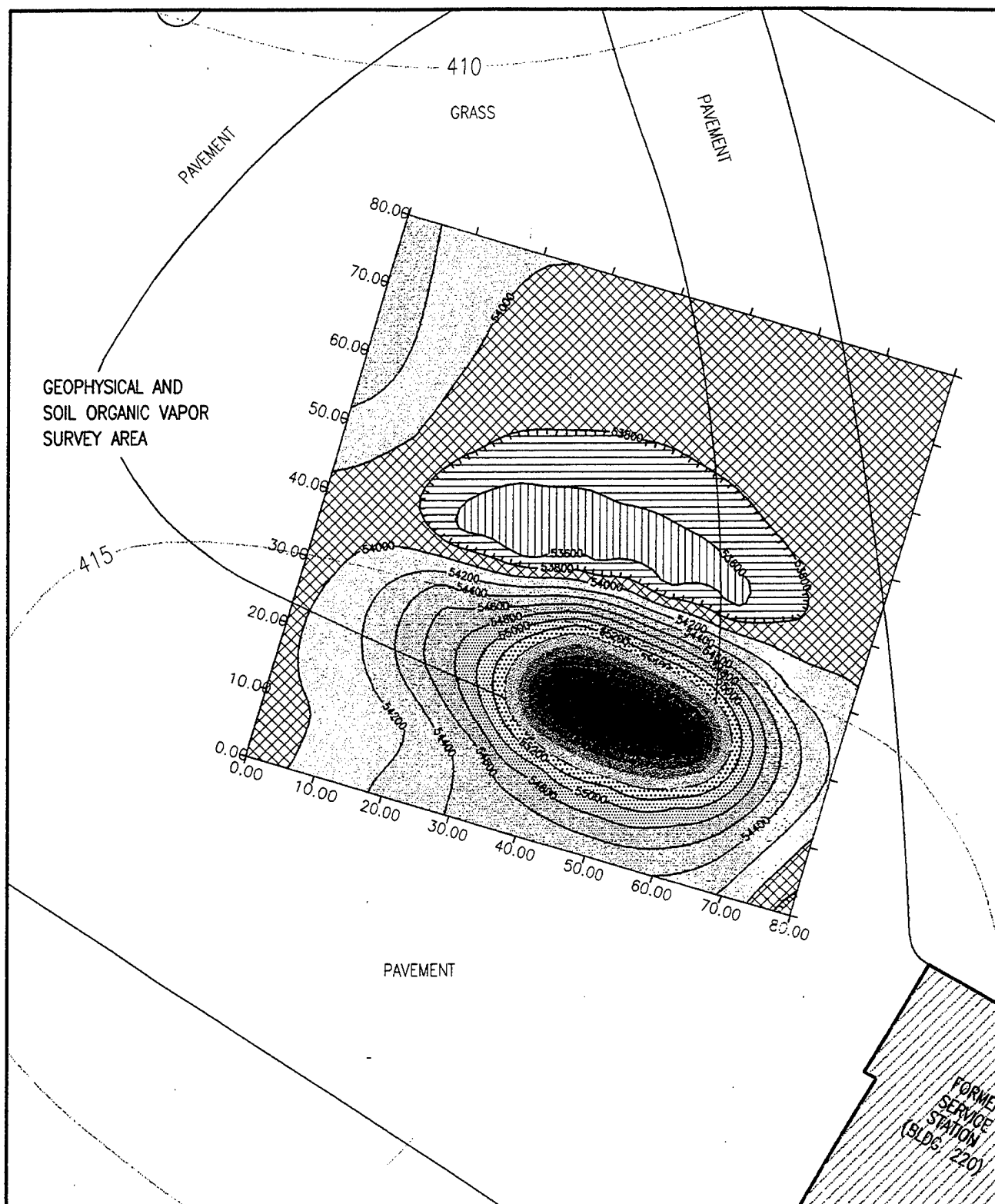
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**AREA 28-5 - FORMER SERVICE STATION  
SOIL BORINGS**

Figure: 3-33	Project: 01-0827-03-6521-062	File Name: /95005/DWGS/036F17C2	Date: 09-08-95
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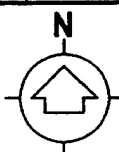




# **LEGEND:**

..... PAVED ROAD  
 ..... SURFACE CONTOUR  
 ..... GEOPHYSICAL CONTOUR

0 10 20  
 SCALE: 1" = 20'



53.4 53.6 53.8 54.0 54.2 54.4 54.6 54.8 55.0 55.2 55.4 55.6 55.8 56.0 56.2 56.4



TOTAL MAGNETIC FIELD (nt)



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**AREA 28-5 - FORMER SERVICE STATION  
MAGNETIC SURVEY DATA**

Figure: 3-35	Project: 01-0827-03-6521-062	File Name: /95005/DWGS/062W2	Date: 09-08-95
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be determined. The magnetic data were less affected by utilities and clearly located large, buried ferromagnetic objects. Neither method could accurately resolve the number of tanks. The EM data and the magnetic data at this AREE were combined to provide an approximate location for the USTs in the south central section of the survey area.

#### **3.6.23.2 Soil Gas Survey Results**

The soil gas survey at this AREE failed to produce acceptable results due to the fine-grained (i.e., clay) nature of the soils. As an alternative method, a soil sample screening survey was performed in which soil samples were collected and the headspace was screened for VOCs at an onsite laboratory.

#### **3.6.23.3 Push Soil Screening Survey**

A total of 40 samples were collected from 27 locations and analyzed for benzene, toluene, ethylbenzene, and xylene (BTEX) compounds, total volatiles, and chlorinated solvents. Figure 3-36 provides total volatiles data for the screening survey. The probes were pushed to 14 feet BLS, and soil samples were collected at one or more of the following intervals: 6 to 8 feet BLS, 9 to 11 feet BLS, and 12 to 14 feet BLS. The screening results indicated the potential for VOC contamination in the soils around the suspected pump island area and the fill pipes. The highest levels of VOC contamination were found in the pump island area (locations A13 and A33) and south of the fill pipes (locations A1 and A2). Four soil boring locations were selected for sampling and confirmatory analysis based on these results.

#### **3.6.23.4 Soil Boring Results**

The soil borings at the Former Service Station Abandoned USTs were sampled at two different depth intervals. Borings at locations SB-SS-001 and SB-SS-003 were sampled in the 11- to 13-foot interval, while borings at locations SB-SS-002 and SB-SS-004 were sampled in the 8- to 10-foot interval. Slight petroleum odors were noted in the soil sampling intervals at locations SB-SS-002 and SB-SS-003. A slight petroleum odor also was noticed in the 1-foot range in boring SB-SS-001. The results of the laboratory analyses for this AREE are provided in Appendix J. Table 3-73 provides the results and residential soil RBCs for those contaminants



**Table 3-73. Data Summary Table: Soil - Former Service Station Abandoned USTs (AREE 28-5)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SB-SS-001	SB-SS-001	SB-SS-002	SB-SS-003	SB-SS-004	Residential RBCs (EPA 1996)
Field Sample Number	SAIC01	SAIC02	SAIC01	SAIC01	SAIC01	
Site Type	BORE	BORE	BORE	BORE	BORE	
Collection Date	11/10/94	11/10/94	11/10/94	11/15/94	11/15/94	
Depth (ft)	11	11	8	11	8	

VOLATILES/SOIL/GCMS (LM23) (ug/g)					
Laboratory ID Number	UB06217	N/A	UB06219	UB06288	UB06289
Parameter	Units	CRL			
1,3-Dimethylbenzene	ug/g	0.23	LT	0.23**	LT
Benzene	ug/g	0.1	LT	0.1**	LT
Ethylbenzene	ug/g	0.19	LT	0.19**	LT
Toluene	ug/g	0.1	LT	0.1**	LT
Methylisobutylketone	ug/g	0.63	LT	0.63**	LT
2-Hexanone	ug/g	1	ND	1** R	ND
Styrene	ug/g	0.6	ND	0.6** R	ND
1,2-Dimethylbenzene	ug/g	0.78	LT	0.78**	LT
TICs	ug/g		0 (0.0)	15 (102.4)	0 (0.0)

Laboratory ID Number	UB06217	N/A	UB06219	UB06288	UB06289
Parameter	Units	CRL			
2-Methylnaphthalene	ug/g	0.032	LT	0.032**	LT
Diethyl Phthalate	ug/g	0.24	LT	0.24**	LT
Naphthalene	ug/g	0.74	LT	0.74**	LT
TICs	ug/g		5 (5.2)	46 (81.2)	2 (1.5)

Laboratory ID Number	UB06217	N/A	UB06219	UB06287	UB06289
Parameter	Units	CRL			
Total Petroleum Hydrocarbons	ug/g	10	LT	39.7**	LT

Laboratory ID Number	UB06217	N/A	UB06219	UB06288	UB06289
Parameter	Units	CRL			
Total Lead	ug/g	0.467	16.9**	17.9**	24.3**

Footnotes:  
 \* - Data collected from chemical transfer file (Phase I)  
 \*\* - Data collected from USAEC Pyramid system (Phase III)  
 CRL - Certified reporting limit  
 ID - Identification  
 N/A - Not applicable  
 QC - Quality control  
 TICs - Tentatively Identified Compound: number of TICs (total value)  
 Boolean Codes  
 LT - Less than the certified reporting limit / method detection level  
 Flagging Codes  
 R - Non-target compound analyzed for but not detected (GC/MS methods).  
 S - Non-target compound analyzed for and detected (GC/MS methods).

detected above the CRL. The maximum lead concentration (24.3  $\mu\text{g/g}$ ) is significantly lower than the EPA screening level for lead in residential soils of 400 ppm (EPA 1994).

The presence of VOCs in the soils was confirmed in the area of the pump island. VOCs detected included the following compounds: 1,3-dimethylbenzene, benzene, ethylbenzene, toluene, methylisobutylketone, 2-hexanone, styrene, and 1,2-dimethylbenzene. SVOCs were detected in the soils in the area of the pump island, and to a lesser extent, in the area just south of the easternmost fill pipe. SVOCs detected included 2-methyl-naphthalene, diethyl phthalate, and naphthalene. None of the VOCs or SVOCs that had a relevant RBC was detected at a concentration higher than its corresponding residential RBC. TPH was detected at one location (SB-SS-003) at a concentration of 39.7  $\mu\text{g/g}$ , which is below the state action level of 100 ppm.

#### **3.6.23.5 Site Assessment**

The push soil screening survey at this AREE determined that volatiles contamination may be present in the soils around the suspected pump island area and the fill pipes. Soil boring samples collected for confirmatory and additional analyses indicated that contamination is present at this AREE. Lead and TPH were both detected in the soils at the Former Service Station Abandoned USTs, although neither contaminant was present at a concentration above its corresponding protection standard. Although the VOCs and SVOCs detected at this AREE are present in concentrations below their residential RBCs, the number and concentrations of organic compounds indicate that gasoline contamination is present. In addition, it is possible that areas of higher contamination may exist closer to the surface in the area of the distribution lines and former pump island. No groundwater samples were collected at this AREE, so potential impact to groundwater remains unknown. Additional investigations at this AREE are recommended and include groundwater monitoring and soil investigation in the areas of the distribution line and former pump island.

#### **3.6.24 AREE 29-1 - Salvage Yard**

The Salvage Yard was active in the mid-1970s as a small fenced storage yard. SI activities at this location consisted of performing a geophysical survey over a 100- by 100-foot area using 10-foot spacings to determine if drums or debris were buried at the AREE.

Figure 3-37 shows the location of the geophysical survey. The electromagnetic and magnetics survey conducted at this AREE detected two large anomalies that may have indicated buried material. A total of seven test pits were excavated to determine the sources of the anomalies. SAIC proposed collection of one soil sample from each anomalous area to send for laboratory analysis; however, these samples were not collected because there was no indication of contamination found as a result of the test pit excavation.

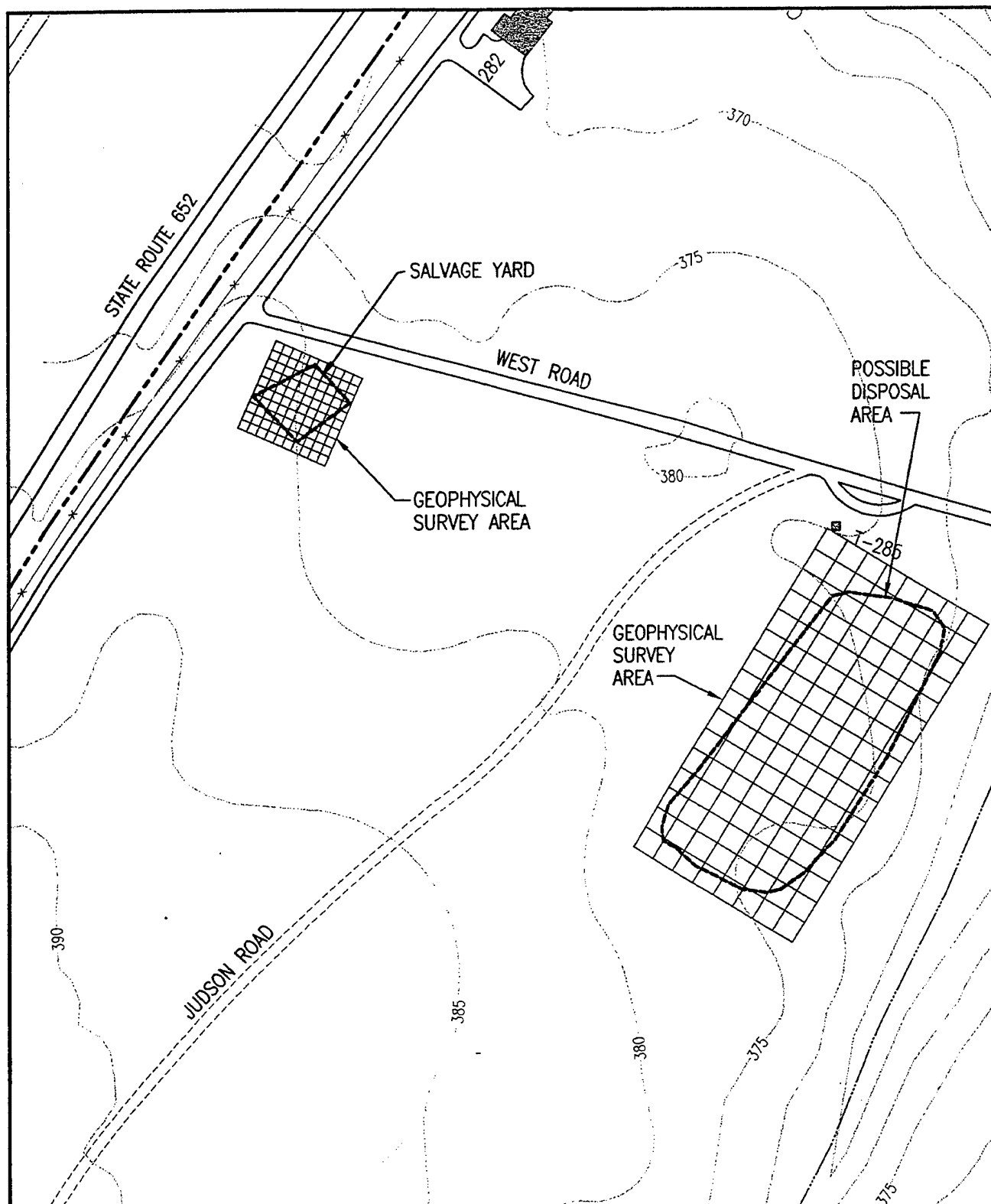
#### **3.6.24.1 Geophysical Survey Results**

Combining the EM and magnetic data leads to a consistent interpretation at the Salvage Yard. The EM data clearly show one anomalous area in the northwest portion of the survey area. The magnetic data show this anomaly and the top side portion of another dipolar anomaly whose source is interpreted as existing to the southwest of the study area. Figure 3-38 provides EM survey data for the Salvage Yard, and Figure 3-39 provides magnetic survey results.

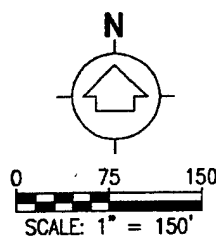
#### **3.6.24.2 Test Pit Results**

Four test pits were excavated in Area 1, the anomalous area at the north-central edge of the Salvage Yard geophysical grid. Three test pits were excavated in Area 2, the anomalous area at the southwest corner of the Salvage Yard geophysical grid. Figure 3-40 shows the locations of the test pits. Each pit was approximately 2 feet wide, 10 feet long, and 3 feet deep. In Area 1, the test pits revealed coarse gravel, concrete chunks, scrap metal, porcelain, wire, pipe, bricks, an automobile shock absorber, and other assorted debris in the first 12 to 16 inches and natural red silt in the lower depths of the pits. Test pit excavation was discontinued approximately 1½ feet below where undisturbed native soil was reached. PID readings taken in the pits did not indicate the presence of VOCs. In Area 2, the test pits revealed no artifacts with the exception of an abandoned 1½-inch diameter cable buried at a depth of approximately 6 inches. No soil samples were collected from any of the test pits because only inert debris was unearthed.

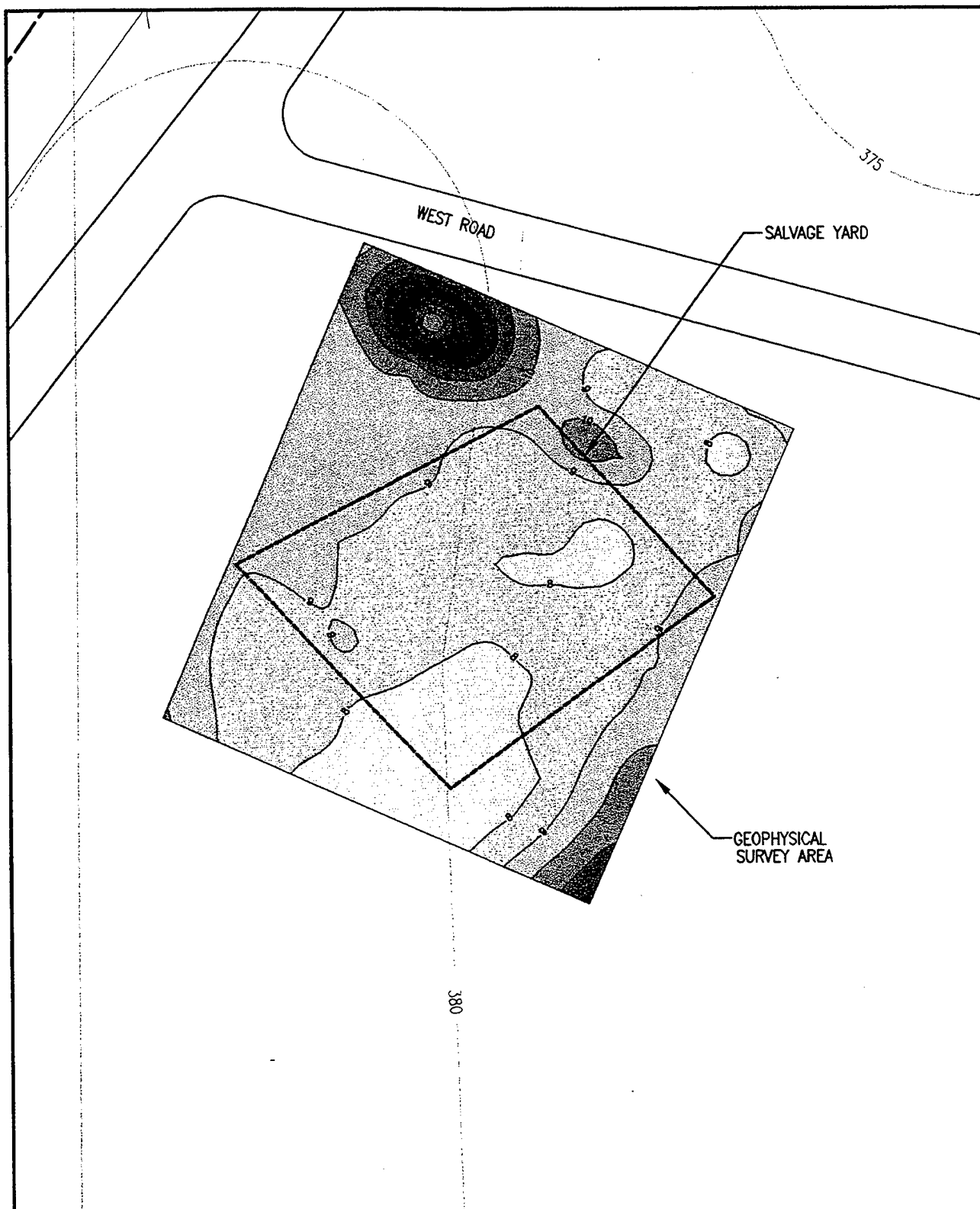




LEGEND	
	BUILDING
	SITE DRAINAGE
	PAVED ROAD
	UNPAVED ROAD
	SITE BOUNDARY

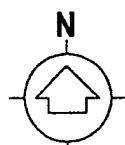
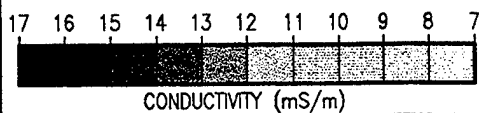


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<b>AREAs 28-1 AND 28-3 - SALVAGE YARD</b> <b>AND POSSIBLE DISPOSAL AREA</b>			
Figure: 3-37	Project: 01-0827-03-6521-062	File Name: 95005\DWGS\0363-14B	Date: 09-08-95



# **LEGEND:**

.....PAVED ROAD  
 .....SURFACE CONTOUR  
 -10- GEOPHYSICAL CONTOUR



0 15 30  
 SCALE: 1" = 30'

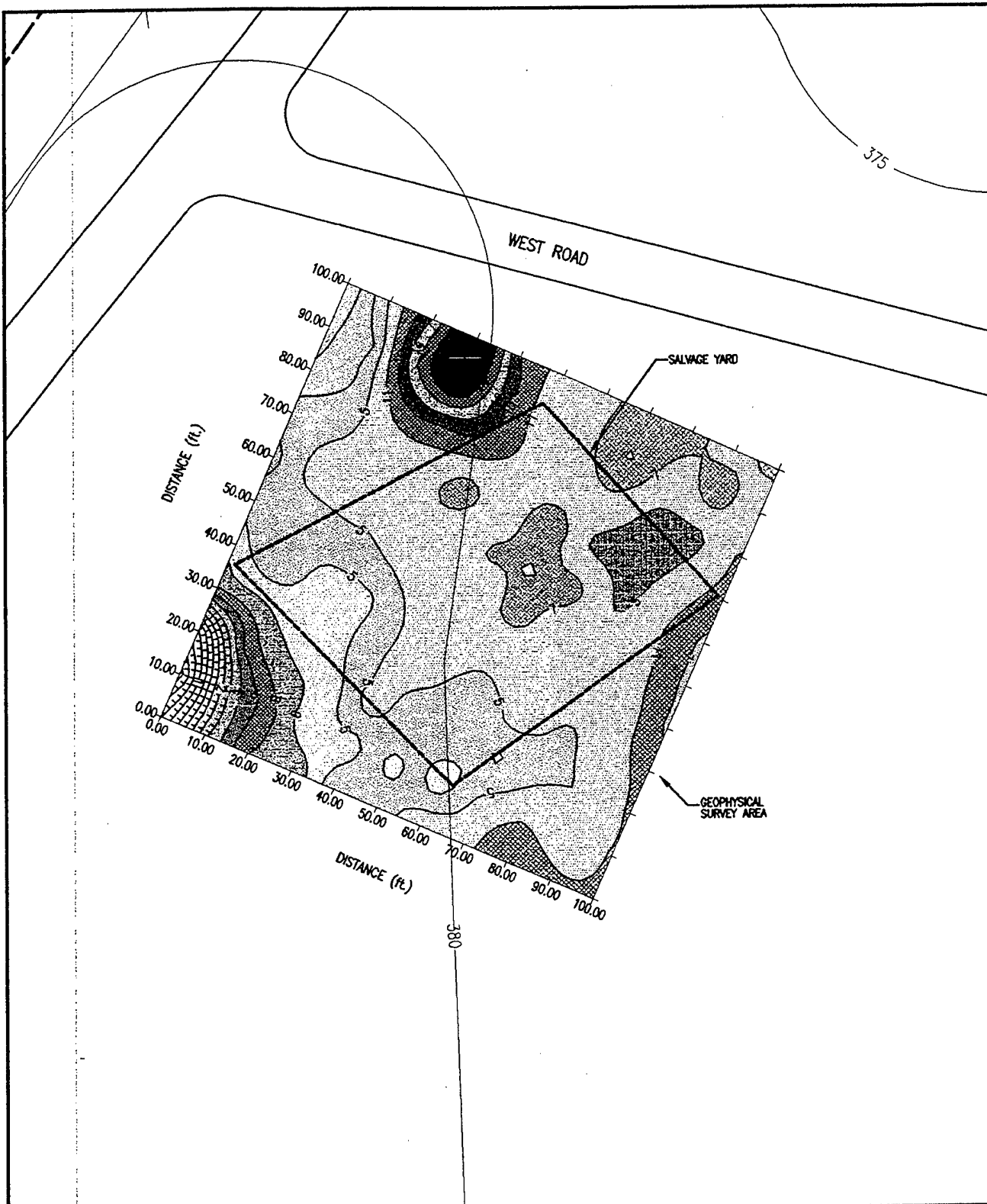


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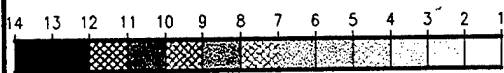
**AREE 28-1 SALVAGE YARD  
 EM SURVEY DATA**

Figure: 3-38	Project: 01-0827-03-6521-062	File Name: 95005\DWGS\062HC1	Date: 09-08-95
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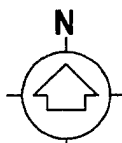


**LEGEND:**

- ..... PAVED ROAD
- ..... SURFACE CONTOUR
- 10- GEOPHYSICAL CONTOUR



TOTAL MAGNETIC FIELD (nT)



0 10 20

APPROX. SCALE: 1" = 20'

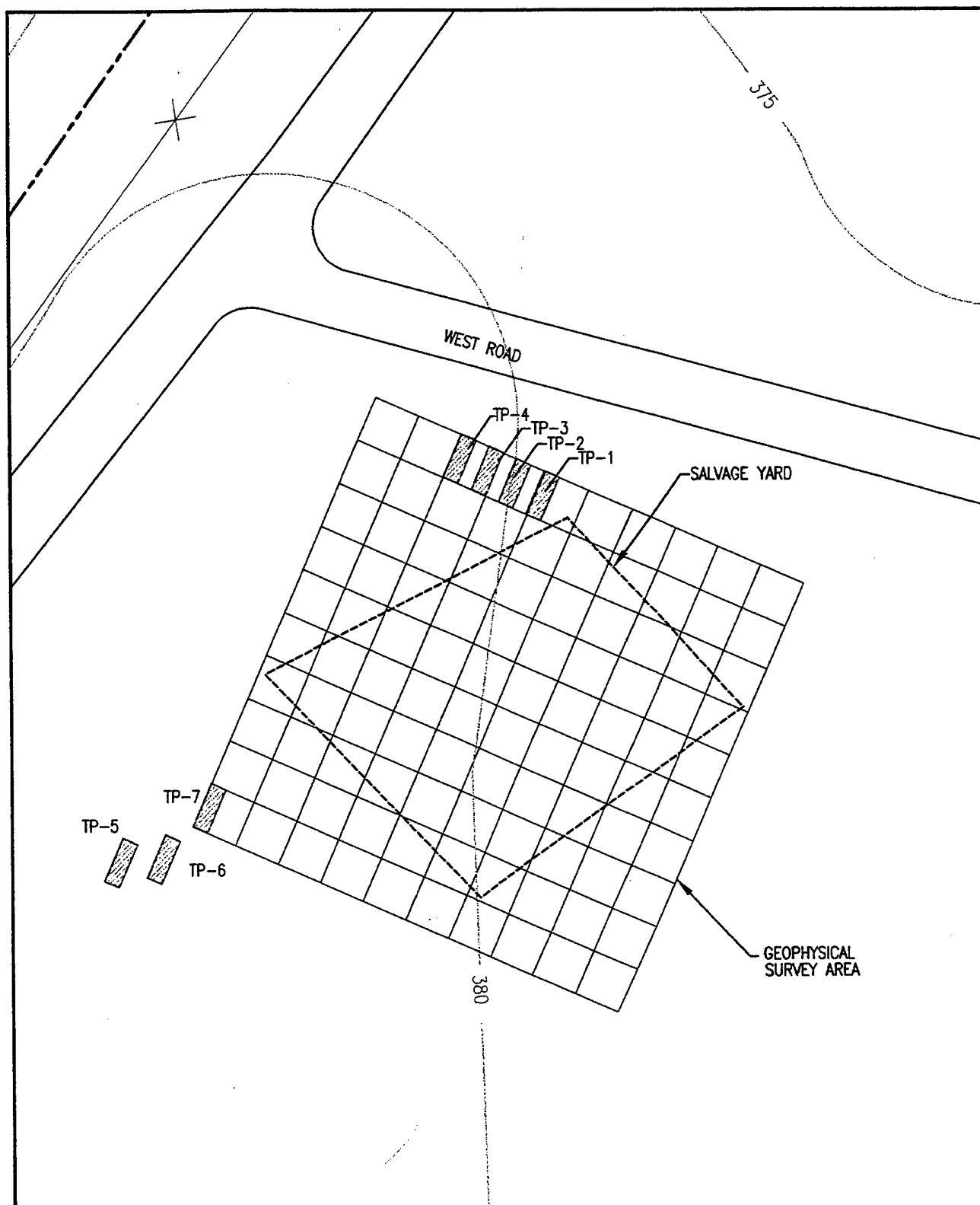


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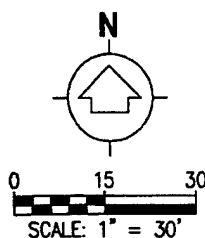
**AREE 29-1 SALVAGE YARD  
MAGNETIC SURVEY DATA**

Figure: 3-39	Project: 01-0827-03-6521-062	File Name: 95005\DWGS\062M1	Date: 09-08-95
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**LEGEND:**

- ..... SITE DRAINAGE
- ===== PAVED ROAD
- UNPAVED ROAD
- SITE BOUNDARY
- ▨ TEST PIT



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**AREE 29-1 SALVAGE YARD TEST PITS**

Figure: 3-40	Project: 01-0827-03-6521-062	File Name: 95005\DWGS\0363-14C	Date: 09-08-95
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### **3.6.24.3 Site Assessment**

No buried drums or non-inert debris were discovered in any of the seven test pits excavated at this site. No further action is recommended for the Salvage Yard. However, due to EPA concerns, a soil sample will be collected and analyzed during Remedial Investigation (RI) activities.

### **3.6.25 AREE 29-2 - Possible Sludge Disposal Area**

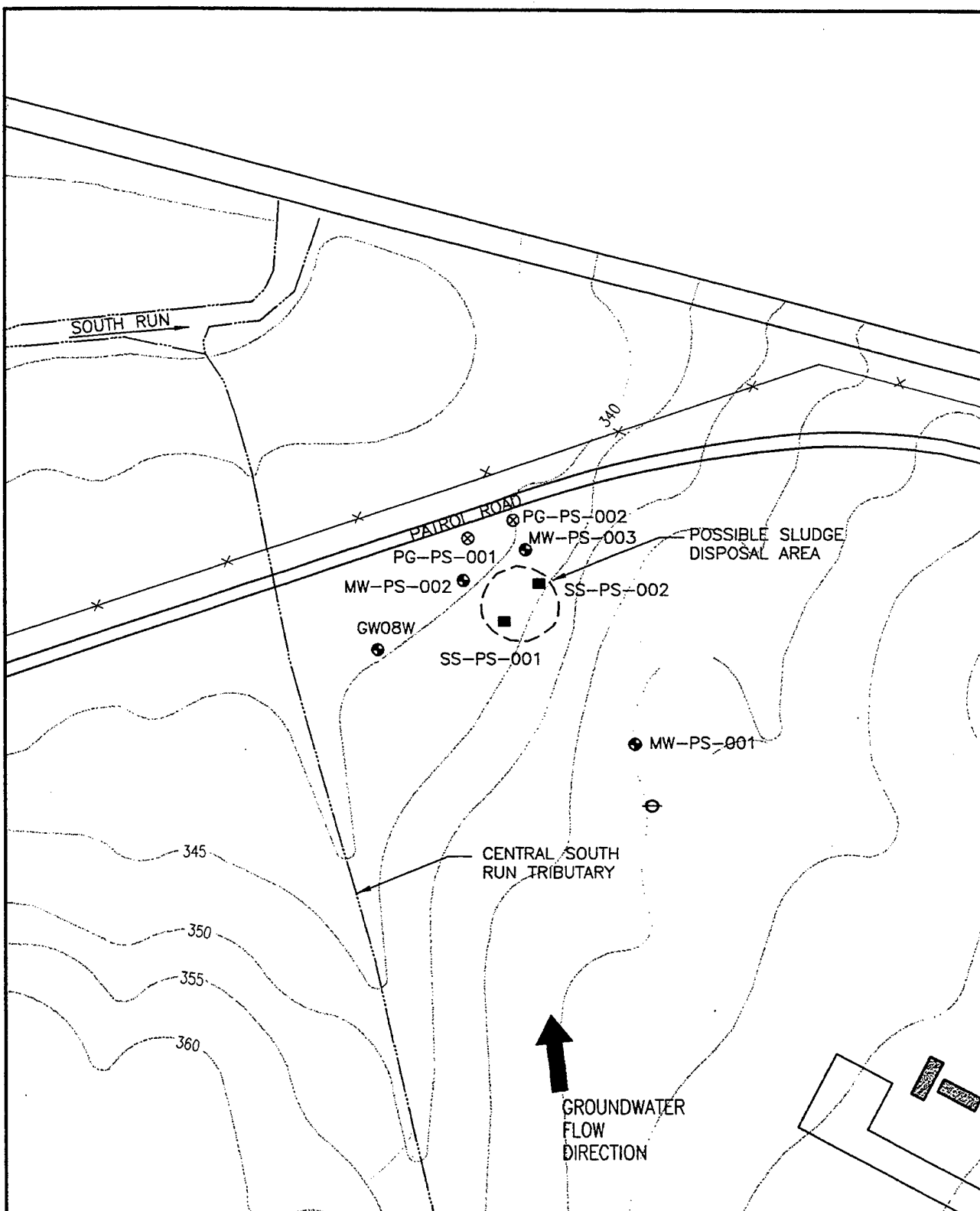
The Possible Sludge Disposal Area was identified through aerial photographs as possibly containing sludge piles during the 1970s. Initial sampling at this AREE consisted of collecting two surface soil samples, sampling one existing well (GW08W), and sampling the two downgradient groundwater push probes. The upgradient push probe was not sampled because it was dry. Followup sampling included installing three groundwater monitoring wells, one of which is upgradient of the area and two of which are downgradient from the area. Figure 3-41 shows the locations of the soil and groundwater samples. The target compounds at this AREE were metals, VOCs, SVOCs, and cyanide.

#### **3.6.25.1 Surface Soil Results**

The results of the surface soil laboratory analyses for the Possible Sludge Disposal Area are provided in Appendix J. Table 3-74 provides the results and RBCs for those analytes detected above the CRL. Two metals (beryllium and iron) were detected above adjusted residential soil RBCs. As shown in Table 3-75, both metals were within background concentrations according to the UTL test. VOCs, SVOCs, and cyanide were not detected in either surface soil sample.

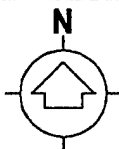
#### **3.6.25.2 Groundwater Results**

The results of the groundwater laboratory analyses for the Possible Sludge Disposal Area are provided in Appendix J. Table 3-76 provides the results for those contaminants detected above the CRL. Two metals (beryllium and manganese) and one VOC (chloromethane) were detected above adjusted tap water RBCs in the monitoring wells. Concentrations of manganese and chloromethane were also above the concentrations detected in the upgradient well



**LEGEND:**

- ..... TRIBUTARY
- ..... STREAM
- \* \* \* \* \* FENCE
- ===== PAVED ROAD
- ..... SURFACE SOIL SAMPLE
- ⊕ ..... GROUNDWATER MONITORING WELL
- ⊗ ..... GROUNDWATER PUSH SAMPLE
- ⊖ ..... DRY PROBE



0 50 100  
SCALE: 1" = 100'



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WARRENTON, VIRGINIA  
SI REPORT**

**AREE 29-2 - POSSIBLE SLUDGE DISPOSAL AREA**

Figure: 3-41	Project: 01-0827-03-6251-062	File Name: 95006\DWGS\249F3-41	Date: 10-04-95
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**Table 3-74. Data Summary Table: Soil - Possible Sludge Disposal Area (AREE 29-2)  
Vint Hill Farms Station, Warrenton, Virginia**

Site ID	Field Sample Number	SS-PS-001	SS-PS-002	Residential RBCs (EPA 1996)	Adjusted RBCs
Site Type	SAIC01	SAIC01	SAIC01		
Collection Date	11/14/94	11/14/94	11/14/94		
Depth (ft)	0	0	0		
<b>METALS/SOIL/GFAA (B9, JD20, JD21) (ug/g)</b>					
Laboratory ID Number	UB06272	UB06274			
Parameter	Units	CRL			
Lead	ug/g	0.467	10.4**	19.6**	N/A
<b>METALS/SOIL/ICP (JS12) (ug/g)</b>					
Laboratory ID Number	UB06272	UB06274			
Parameter	Units	CRL			
Aluminum	ug/g	11.2	26900**	78000	39000
Barium	ug/g	3.29	103**	90.4**	5500
Beryllium	ug/g	0.427	1.18**	0.809**	0.15c/390n
Calcium	ug/g	25.3	1200**	1610**	N/A
Cobalt	ug/g	2.5	16.7**	14.5**	4700
Chromium	ug/g	1.04	36.6**	32.3**	390
Copper	ug/g	2.84	36.2**	11.7**	3100
Iron	ug/g	6.66	40400**	35600**	23000
Potassium	ug/g	131	877**	1250**	N/A
Magnesium	ug/g	10.1	5610**	3690**	N/A
Manganese	ug/g	9.87	480**	371**	10950
Sodium	ug/g	38.7	38.7**	63.6**	N/A
Nickel	ug/g	2.74	22.6**	14.8**	1600
Vanadium	ug/g	1.14	51.6**	51.6**	550
Zinc	ug/g	2.34	71.9**	64.4**	23000
<b>SEMIVOLATILES/SOIL/GCMS (LM25) (ug/g)</b>					
Laboratory ID Number					
Parameter	Units	CRL			
TICs	ug/g	7 (4.8)	25 (39.7)		N/A

**Footnotes:**

\* - Data collected from chemical transfer file (Phase I)  
\*\* - Data collected from USAEC Pyramid system (Phase III)

CRL - Certified reporting limit

ID - Identification

N/A - Not applicable

QC - Quality control

TICs - Tentatively Identified Compound: number of TICs (total value)

Boolean Codes

LT - Less than the certified reporting limit / method detection level

**Table 3-75. Background Soil Comparison-Possible Sludge Disposal Area (AREE 29-2)  
Vint Hill Farms Station, Warrenton, Virginia**

Substance	AREE 29-2 (PS) SOIL					Differs from Background?
	P,t,s	P,t,p	P,m-w	UTL (ppm)	% > UTL	Upper Tail (UTL test)
Aluminum	-	-	-	-	-	-
Arsenic	-	-	-	-	-	-
Barium	-	-	-	-	-	-
Beryllium	-	-	-	5.10	0%	no
Cadmium	-	-	-	-	-	-
Calcium	-	-	-	-	-	-
Chromium	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-
Copper	-	-	-	-	-	-
Iron	-	-	-	180000.00	0%	no
Lead	-	-	-	-	-	-
Magnesium	-	-	-	-	-	-
Manganese	-	-	-	-	-	-
Mercury	-	-	-	-	-	-
Nickel	-	-	-	-	-	-
Potassium	-	-	-	-	-	-
Selenium	-	-	-	-	-	-
Silver	-	-	-	-	-	-
Sodium	-	-	-	-	-	-
Thallium	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-
Zinc	-	-	-	-	-	-

**Notes:**

P,t,s - t-test type I error probability assuming separate (or unequal) variances

P,t,p - t-test type I error probability assuming pooled (or equal) variances

P,m-w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples



**Table 3-76. Data Summary Table: Groundwater - Possible Sludge Disposal Area (AREE 29-2)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	GW09W	MW-PS-001	MW-PS-002	MW-PS-002	MW-PS-003
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC02	SAIC01
Site Type	WELL	WELL	WELL	WELL	WELL
Collection Date	11/11/94	6/15/95	6/15/95	6/15/95	6/15/95
Depth (ft)	2.83	11.11	8.55	8.55	10.4
Associated Field QC Sample - Site ID					
Associated Field QC Sample - Field Sample No.					
Associated Field QC Sample - Site ID					
Associated Field QC Sample - Field Sample No.					

<b><u>METALS/WATER/GFAA (AX6, SD16, SD25, 7041) (ug/L)</u></b>					
Laboratory ID Number	UB06249	UC01858	UC01855	UC01856	UC01857
Parameter	Units	CRL			
Lead	ug/L	4.47	LT	4.47*	LT
					4.47*

<b><u>METALS/WATER/CVAA (CC9) (ug/L)</u></b>					
Laboratory ID Number	UB06249	UC01858	UC01855	UC01856	UC01857
Parameter	Units	CRL			
Mercury	ug/L	0.1	LT	0.1*	LT
					0.1*

<b><u>METALS/WATER/ICP (SS12, 6010) (ug/L)</u></b>					
Laboratory ID Number	UB06249	UC01858	UC01855	UC01856	UC01857
Parameter	Units	CRL			
Aluminum	ug/L	112	2750**	1860* D	559*
Barium	ug/L	2.82	85.6**	133* D	54.4*
Beryllium	ug/L	1.12	1.12**	1.12* D	1.12*
Calcium	ug/L	105	14600**	31200* D	20600*
Cobalt	ug/L	25	25**	25* D	25*
Chromium	ug/L	16.8	16.8**	16.8* D	16.8*
Copper	ug/L	18.8	18.8**	18.8* D	18.8*
Iron	ug/L	77.5	4330**	2880* D	766*
Potassium	ug/L	1240	1720**	2060* D	1240*
Magnesium	ug/L	135	6730**	8180* D	4890*
Manganese	ug/L	9.67	306**	156* D	8180*
Sodium	ug/L	279	10600**	10900* D	32.1*
Nickel	ug/L	32.1	32.1**	32.1* D	10*
Thallium	ug/L	2.44	2.44**	10* D	10*
Vanadium	ug/L	27.6	27.6**	27.6* D	27.6*
Zinc	ug/L	18	24**	22.6* D	18*

<b><u>VOLATILES/WATER/GCMS (UM21) (ug/L)</u></b>					
Laboratory ID Number	UB06249	UC01858	UC01855	UC01856	UC01857
Parameter	Units	CRL			
Acetone	ug/L	8	LT	8* D	8*
Chloromethane	ug/L	1.2	LT	1.2* D	1.59*
Methyl/ethylketone	ug/L	10	LT	10* D	10*

**Table 3-76. Data Summary Table: Groundwater - Possible Sludge Disposal Area (AREE 29-2)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	GW08W	MW-PS-001	MW-PS-002	MW-PS-002	MW-PS-003
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01
Site Type	WELL	WELL	WELL	WELL	WELL
Collection Date	11/11/94	6/15/95	6/15/95	6/15/95	6/15/95
Depth (ft)	2.83	11.11	8.55	8.55	10.4
Associated Field QC Sample - Site ID					
Associated Field QC Sample - Field Sample No.					
Associated Field QC Sample - Site ID					
Associated Field QC Sample - Field Sample No.					
<b>POLYNUCLEAR AROMATIC HYDROCARBONS/WATER (3310) (ug/L)</b>					
Laboratory ID Number	UB06249	UC01858	UC01855	UC01856	UC01857
Parameter	Units	CRL			
Benz(a)fluoranthene	ug/L	0.019	LT	0.0193**	0.0521* G
			LT	0.0198* D	LT
					0.0198*

**Table 3-76. Data Summary Table: Groundwater - Possible Sludge Disposal Area (AREE 29-2)**  
**Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	PG-PS-002	Residential Tap Water RBCs	Adjusted Tap Water RBCs
Field Sample Number	SAIC01		
Site Type	WELL		
Collection Date	11/16/94		
Depth (ft)	1.91		
Associated Field QC Sample - Site ID			
Associated Field QC Sample - Field Sample No.			
Associated Field QC Sample - Site ID			
Associated Field QC Sample - Field Sample No.			
<b>METALS/WATER/GFAA (AX8, SD18, SD25, 7040) (ug/L)</b>			
Laboratory ID Number	UB06301		
Parameter	Units	CRL	
Lead	ug/L	4.47	1400**
<b>METALS/WATER/CVAA (CC8) (ug/L)</b>			
Laboratory ID Number	UB06301		
Parameter	Units	CRL	
Mercury	ug/L	0.1	1.16**
<b>METALS/WATER/ICP (SS12, 6010) (ug/L)</b>			
Laboratory ID Number	UB06301		
Parameter	Units	CRL	
Aluminum	ug/L	112	37000
Barium	ug/L	2.82	2600
Beryllium	ug/L	1.12	0.0162/182n
Calcium	ug/L	105	N/A
Cobalt	ug/L	25	2200
Chromium	ug/L	16.8	180
Copper	ug/L	18.8	1500
Iron	ug/L	77.5	11000
Potassium	ug/L	1240	5500
Magnesium	ug/L	135	
Manganese	ug/L	9.67	90
Sodium	ug/L	279	
Nickel	ug/L	32.1	
Thallium	ug/L	2.44	28.6** JI
Vanadium	ug/L	27.6	3800**
Zinc	ug/L	18	2900**

<b>VOLATILES/WATER/GCMS (UM21) (ug/L)</b>			
Laboratory ID Number	UB06301		
Parameter	Units	CRL	
Acetone	ug/L	8	230** A
Chloromethane	ug/L	1.2	1.2**
Methylethylketone	ug/L	10	500**

**Table 3-76. Data Summary Table: Groundwater - Possible Sludge Disposal Area (AREE 29-2)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	PG-PS-002	Residential Tap Water RBCs
Field Sample Number	SAIC01	(EPA 1996)
Site Type	WELL	
Collection Date	11/16/94	
Depth (ft)	1.91	
Associated Field QC Sample - Site ID		
Associated Field QC Sample - Field Sample No.		
Associated Field QC Sample - Site ID		
Associated Field QC Sample - Field Sample No.		
<b>POLYNUCLEAR AROMATIC HYDROCARBONS/WATER (B310) (ug/L)</b>		
Laboratory ID Number	UB06370	
Parameter	Units	CRL
Benzo(k)fluoranthene	ug/L	0.019 LT 0.0193**
		0.92

**Footnotes:**

\* - Data collected from chemical transfer file (Phase I)  
 \*\* - Data collected from USAEC Pyramid system (Phase III)  
 CRL - Certified reporting limit  
 ID - Identification  
 N/A - Not applicable  
 N/F - Analysis requested, not yet received  
 QC - Quality control  
 TICs - Tentatively Identified Compound: number of TICs (total value)  
 Boolean Codes  
 LT - Less than the certified reporting limit / method detection level

**Flagging Codes**  
 D - Duplicate analysis  
 I - Interferences in sample make quantitation and/or identification to be suspect  
 J - Value is estimated  
 G - Analyte was found in the rinse blank as well as the field sample.  
 A - Analyte was found in the trip blank as well as the field sample.  
 For analytes flagged with "A," "G," "B," "U," or "I," half the detected value was compared with the RBC.

(MW-PS-001). None of the contaminants was detected at a concentration above drinking water MCLs. SVOCs and cyanide were not detected in any of the groundwater samples.

The metals concentrations in the samples collected from the push probes are extremely high due to the levels of sediment in the samples. These data are considered to be nonrepresentative of groundwater conditions at this AREE; therefore, comparison to tap water RBCs or drinking water MCLs for the push probe metals data was not conducted. The samples from the two push probes did not contain target SVOCs or cyanide. No VOCs were detected in the samples from either probe, with the exception of acetone and methyl ethyl ketone. Both compounds are common laboratory contaminants, and the acetone result from probe PG-PS-002 was flagged because acetone was detected in the associated trip blank.

### 3.6.25.3 Streamlined Risk Assessment

A streamlined risk assessment was conducted for current and future land uses at AREE 29-2. Risks were calculated only for the soil ingestion pathway. As shown in Table 3-77, noncancer HIs did not exceed 1 and cancer risks did not exceed  $1 \times 10^{-4}$  for either the station or the construction worker. Under a residential land use scenario, noncancer HIs did not exceed 1 and cancer risks did not exceed  $1 \times 10^{-4}$  for either the child or adult receptor.

**Table 3-77. Risk Characterization Summary for Soil Ingestion at the Possible Sludge Disposal Area (AREE 29-2)**

Current Land Use				Future Land Use			
Noncancer HI		Cancer Risk		Noncancer HI		Cancer Risk	
Station Worker	Construction Worker	Station Worker	Construction Worker	Resident Child	Resident Adult	Resident Child	Resident Adult
0.04	0.2	2E-06	1E-06	0.5	0.05	6E-06	3E-06

### 3.6.25.4 Site Assessment

Two metals (beryllium and iron) were detected in the surface soils above adjusted residential soil RBCs, but were within background levels. No VOCs, SVOCs, or cyanide were

detected in either of the two surface soil borings. The streamlined risk assessment results for the soil ingestion pathway do not exceed EPA target levels under current or future land use scenarios. Therefore, no further soil investigations are recommended at the Possible Sludge Disposal Area. However, at the request of EPA, soil samples will be collected during the RI for additional parameters to further characterize the site.

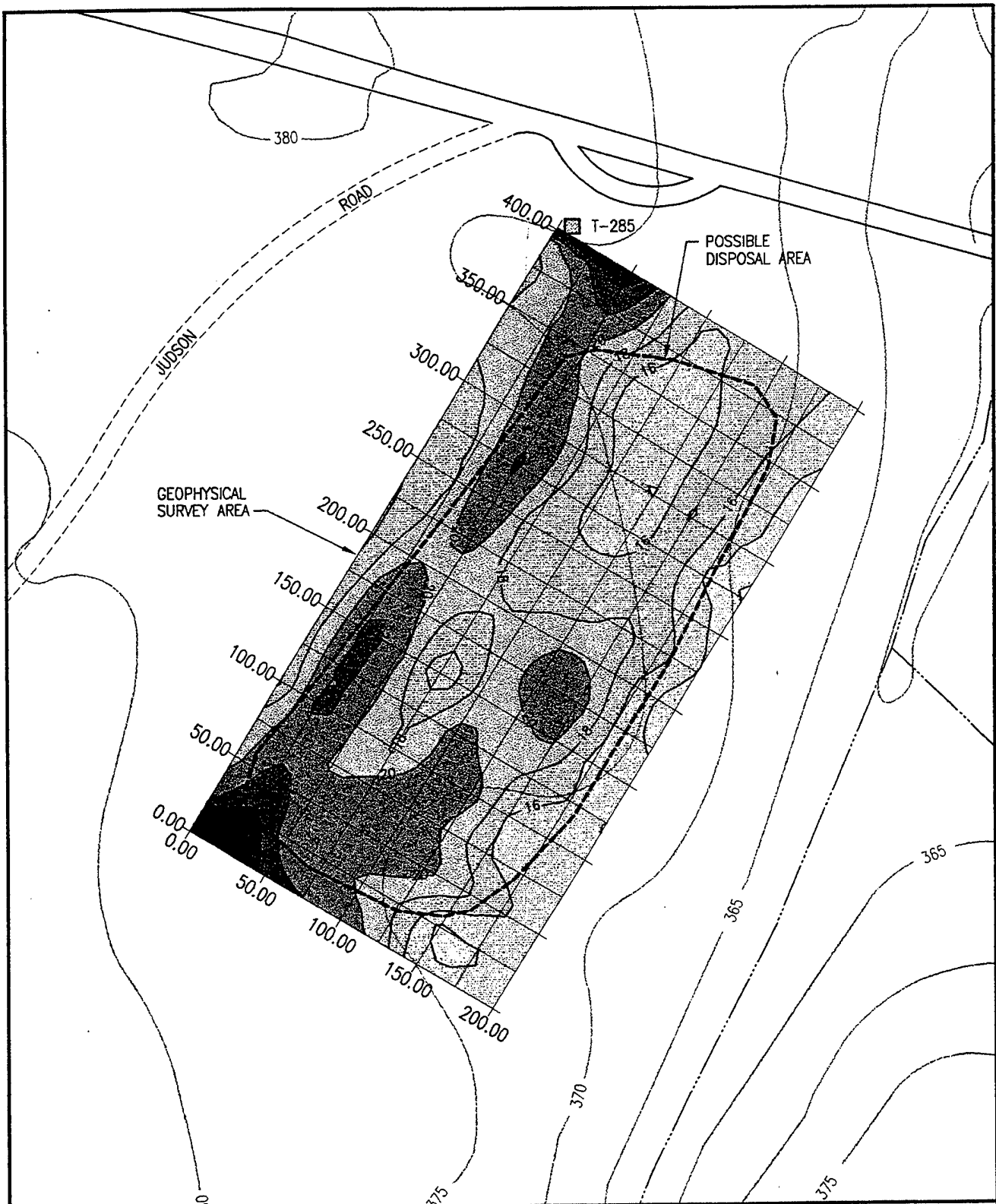
Two metals (beryllium and manganese) and chloromethane exceeded adjusted tap water RBCs in the groundwater at AREE 29-2. These contaminants are present at very low concentrations and do not exceed drinking water MCLs. An additional round of groundwater sampling is recommended for this AREE.

#### ***3.6.26 AREE 29-3 - Possible Disposal Area***

The Possible Disposal Area was identified by aerial photographs as being a possible debris disposal area during the 1950s. SI activities at this AREE consisted of conducting a geophysical survey over a 200- by 400-foot area to identify whether materials are buried within the AREE. Figure 3-37 shows the location of the geophysical survey.

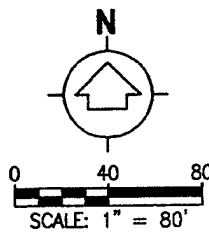
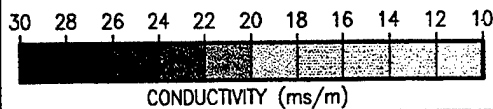
##### **3.6.26.1 Geophysical Survey Results**

The EM and magnetic data interpretations at the Possible Disposal Area led to inconclusive evidence for buried debris disposed of in this area. The EM readings in this area, specifically the in-phase data, do not indicate that buried metallic material is present. Although there are some small EM anomalies, they do not correspond with those found in the magnetic data. Magnetic anomalies suggest some ferromagnetic material could be buried at the site. Figure 3-42 provides the EM survey results for this AREE, while Figure 3-43 provides the magnetic survey data. These data could be exhibiting lithologic or structural changes in the rock and soil or may represent isolated portions of field where small amounts of material were disposed of, and therefore, are interpreted as inconclusive.



**LEGEND:**

- ..... TRIBUTARY
- ===== PAVED ROAD
- ..... SURFACE CONTOUR
- ..... GEOPHYSICAL CONTOUR

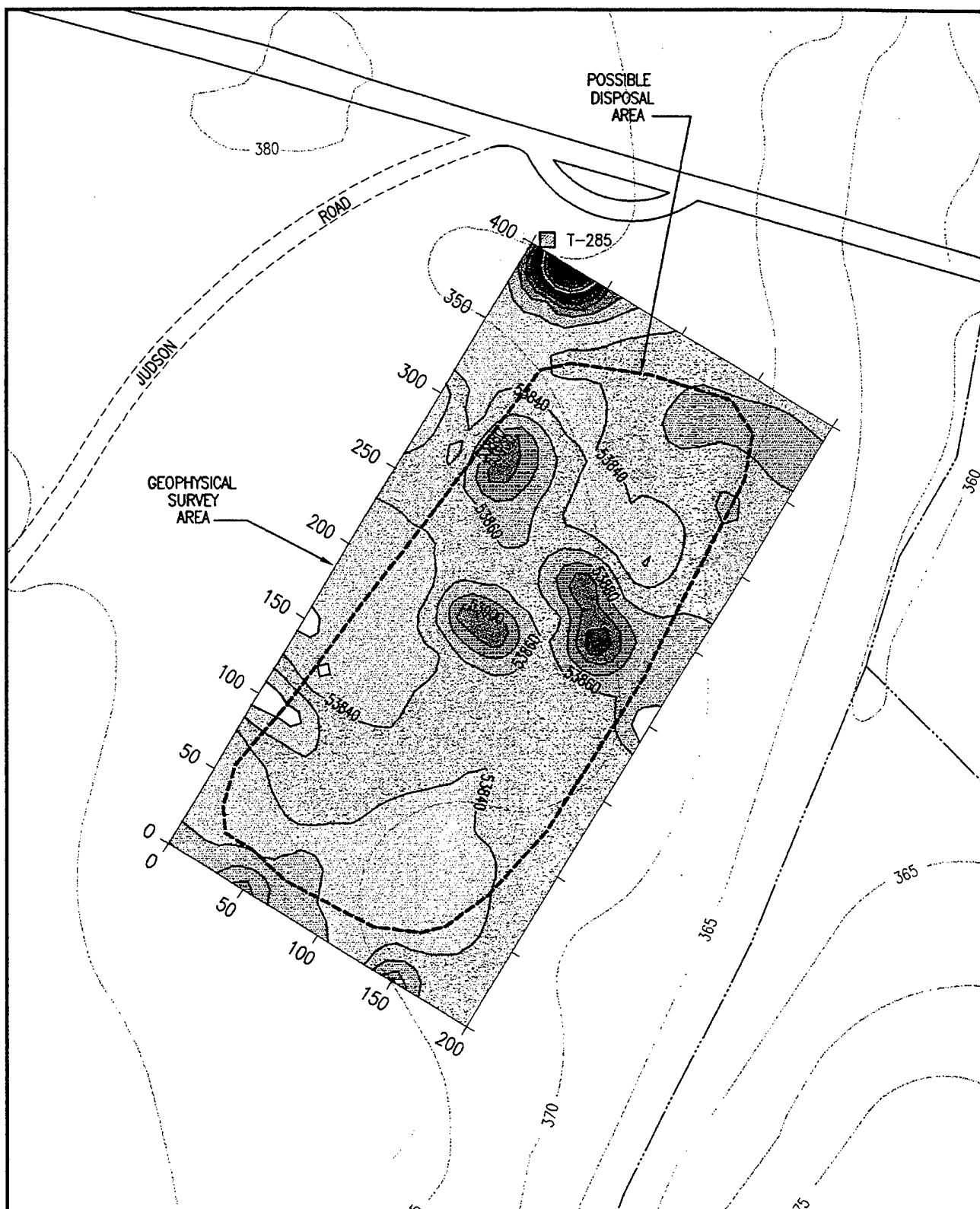


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**AREA 20-3 POSSIBLE DISPOSAL AREA  
EM SURVEY DATA**

Figure: 3-42	Project: 01-0827-03-6521-062	File Name: 95005\DWGS\062VC1	Date: 09-08-95
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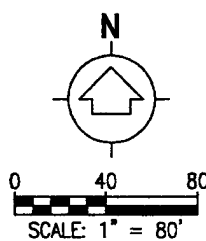
# **LEGEND:**

- ..... SITE DRAINAGE
- ..... PAVED ROAD
- 8 ..... GEOPHYSICAL CONTOUR
- 380 ..... SURFACE CONTOUR

54.00 53.98 53.96 53.94 53.92 53.90 53.88 53.86 53.84 53.82



TOTAL MAGNETIC FIELD (nt) (IN THOUSANDS)



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**AREA 29-3 POSSIBLE DISPOSAL AREA  
MAGNETIC SURVEY DATA**

Figure: 3-43	Project: 01-0827-03-6521-062	File Name: 95005\DWGS\062TMF	Date: 09-08-95
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### 3.6.26.2 Site Assessment

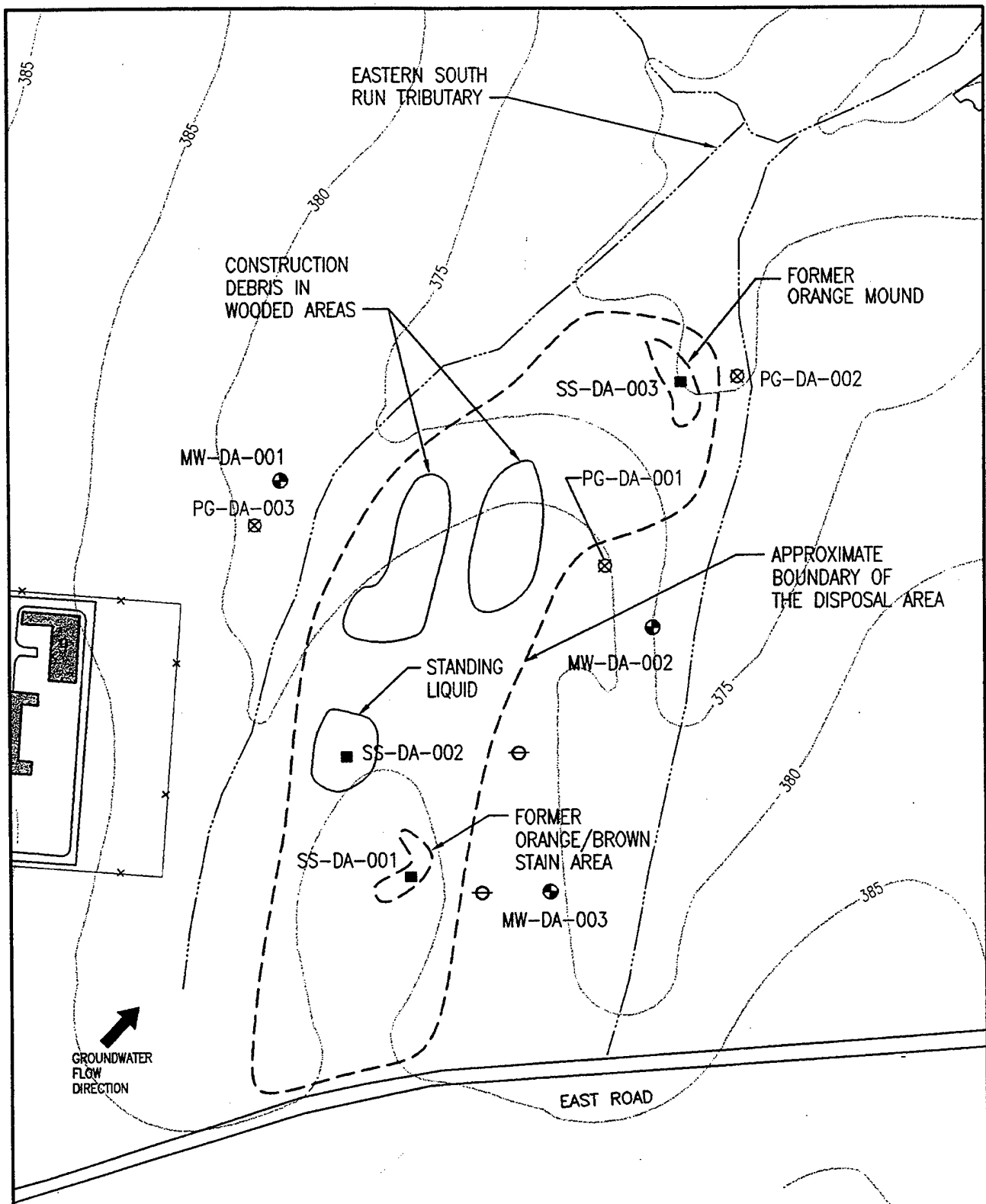
The geophysical survey data collected at the Possible Disposal Area are inconclusive. Additional investigations should be conducted to determine whether buried materials are present. Test pits in the areas of the geophysical anomalies are recommended.

### 3.6.27 AREE 29-4 - Disposal Area


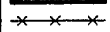
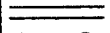
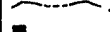
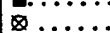

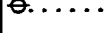
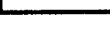
The Disposal Area was identified through aerial photographs as an area of disposal for construction debris and/or liquids and possibly for storage of other materials. Initial sampling at this AREE consisted of collecting three surface soil samples and sampling two downgradient and one upgradient push probe. Followup investigations consisted of installing and sampling three groundwater monitoring wells, one of which is upgradient of the area and two of which are downgradient from the area. The surface soil samples and groundwater probes are shown in Figure 3-44. One downgradient push probe was not sampled because it was dry. The target compounds at this AREE were metals, VOCs, SVOCs, pesticides, and PCBs.

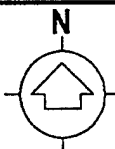
#### 3.6.27.1 Surface Soil Results

The results of the surface soil laboratory analyses for the Disposal Area are provided in Appendix J. Table 3-78 provides the results and RBCs for those contaminants detected above the CRL. Four metals (aluminum, beryllium, iron, and vanadium) were detected at concentrations above their adjusted residential soil RBCs. As shown in Table 3-79, beryllium, iron, and vanadium were within background concentrations according to the UTL test, whereas aluminum exceeded background concentrations in one sample (SS-DA-003) according to the UTL test. The maximum concentration of aluminum (85,000  $\mu\text{g/g}$ ) is within two standard deviations of the regional concentration of aluminum (33,000  $\mu\text{g/g}$ ) (Shacklette and Boerngen 1984). The surface soil sample from the former orange mound (SS-DA-003) contained the highest concentrations of metals. No VOCs, SVOCs, pesticides, or PCBs were detected in any of the surface soil samples from this AREE.



**LEGEND:**

-  BUILDING
-  FENCE
-  PAVED ROAD
-  TRIBUTARY
-  SURFACE SOIL SAMPLE
-  GROUNDWATER PUSH SAMPLE
-  GROUNDWATER MONITORING WELL
-  DRY PROBE



0 50 100 150  
SCALE: 1" = 150'



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**AREE 29-4 - DISPOSAL AREA**

Figure: 3-44	Project: 01-0827-03-6251-062	File Name: 95005\DWGS\249F3-44	Date: 10-04-95
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**Table 3-78. Data Summary Table: Soil - Disposal Area (AREE 29-4)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	SS-DA-001	SS-DA-002	SS-DA-003	Residential RBCs Adjusted RBCs
Field Sample Number	SAIC01	SAIC01	SAIC01	(EPA 1996)
Site Type	SURF	SURF	SURF	
Collection Date	11/11/94	11/11/94	11/11/94	
Depth (ft)	0	0	0	

<b>METALS/SOIL/GFAA (B6, JD20, JD21) (ug/g)</b>			
Laboratory ID Number	UB06235	UB06236	UB06238
Parameter	Units	CRL	
Lead	ug/g	0.467	18.2**
		14** D	13.2**
			8.94**
			N/A

<b>METALS/SOIL/ICP (JS12) (ug/g)</b>			
Laboratory ID Number	UB06235	UB06236	UB06238
Parameter	Units	CRL	
Aluminum	ug/g	11.2	38000**
Barium	ug/g	3.29	25800** D
Beryllium	ug/g	0.427	74.6** D
Calcium	ug/g	25.3	0.986** D
Cobalt	ug/g	2.5	228** D
Chromium	ug/g	1.04	10.3** D
Copper	ug/g	2.94	35.2** D
Iron	ug/g	6.66	56.6** D
Potassium	ug/g	131	63100** D
Magnesium	ug/g	10.1	4280** D
Manganese	ug/g	9.87	5340** D
Sodium	ug/g	38.7	1520** D
Nickel	ug/g	2.74	216** D
Vanadium	ug/g	1.14	63.2** D
Zinc	ug/g	2.34	25.4** D
			65.1** D
			40.8** D
			74.6**
			160000**
			59.5**
			3100
			390
			4700
			N/A
			1320**
			2.15**
			334**
			85000**
			78000
			15600
			0.15c390h
			78
			4800
			2190
			1600
			550
			110
			134**
			23000

<b>VOLATILES/SOIL/GCMS (LM23) (ug/g)</b>			
Laboratory ID Number	UB06235	UB06236	UB06238
Parameter	Units	CRL	
TICs	ug/g	0 (0.0)	0 (0.0)
		0 (0.0)	1 (4.0)
			N/A

<b>SEMI-VOLATILES/SOIL/GCMS (LM25) (ug/g)</b>			
Laboratory ID Number	UB06235	UB06236	UB06238
Parameter	Units	CRL	
TICs	ug/g	9 (5.1)	7 (3.9)
		10 (7.1)	54 (74.3)
			N/A

Footnotes:  
 \* - Data collected from chemical transfer file (Phase I)  
 \*\* - Data collected from USAEC Pyramid system (Phase III)  
 CRL - Certified reporting limit  
 ID - Identification  
 N/A - Not applicable  
 QC - Quality control  
 TICs - Tentatively Identified Compound: number of TICs (total value)  
 Boolean Codes  
 LT - Less than the certified reporting limit / method detection level  
 Flagging Codes  
 D - Duplicate analysis.

**Table 3-79. Background Soil Comparison-Disposal Area (AREE 29-4)  
Vint Hill Farms Station, Warrenton, Virginia**

Substance	AREE 29-4 (DA) SOIL					Differs from Background?
	P,t,s	P,t,p	P,m-w	UTL (ppm)	% > UTL	
						Upper Tail (UTL test)
Aluminum	-	-	-	60600.00	33%	yes
Arsenic	-	-	-	-	-	-
Barium	-	-	-	-	-	-
Beryllium	-	-	-	5.10	0%	no
Cadmium	-	-	-	-	-	-
Calcium	-	-	-	-	-	-
Chromium	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-
Copper	-	-	-	-	-	-
Iron	-	-	-	180000.00	0%	no
Lead	-	-	-	-	-	-
Magnesium	-	-	-	-	-	-
Manganese	-	-	-	-	-	-
Mercury	-	-	-	-	-	-
Nickel	-	-	-	-	-	-
Potassium	-	-	-	-	-	-
Selenium	-	-	-	-	-	-
Silver	-	-	-	-	-	-
Sodium	-	-	-	-	-	-
Thallium	-	-	-	-	-	-
Vanadium	-	-	-	531.00	0%	no
Zinc	-	-	-	-	-	-

**Notes:**

P,t,s - t-test type I error probability assuming separate (or unequal) variances

P,t,p - t-test type I error probability assuming pooled (or equal) variances

P,m-w - Mann-Whitney test type I error probability

% >UTL - percentage of detected compounds above the UTL

NA - too few samples for test

NDA - not detected in AREE samples, but detected in background

NDB - not detected in background samples, but detected at AREE

NDBA - not detected in background or AREE samples

### 3.6.27.2 Groundwater Results

The results of the groundwater laboratory analyses for the Disposal Area are provided in Appendix J. Table 3-80 provides the results for those analytes detected above the CRL. Four metals (arsenic, beryllium, iron, and manganese) were detected above adjusted tap water RBCs in the monitoring wells. As shown in Table 3-81, beryllium also exceeded the drinking water MCL. A background groundwater comparison could not be performed because the local groundwater flow shifted from eastward to northeastward and MW-DA-001 was no longer upgradient of MW-DA-002 and MW-DA-003 (see Section 3.1.2). No VOCs, SVOCs, pesticides, or PCBs were detected in any of the monitoring wells.

The metals concentrations in the samples collected from the push probes are extremely high due to the levels of sediment in the samples. These data are considered to be nonrepresentative of groundwater conditions at this AREE; therefore, comparison to tap water RBCs or MCLs for the push probe metals data was not conducted. No target SVOCs, pesticides, or PCBs were detected in any of the push probe samples collected from this AREE. No VOCs were detected in the samples from the probes, with the exception of acetone and methyl ethyl ketone. Both compounds are common laboratory contaminants. The push probe located at PG-DA-001 did not furnish sufficient water for SVOC, PAH, PCP, hexachlorobenzene, hexachlorocyclopentadiene, pesticide, or PCB analyses.

### 3.6.27.3 Site Assessment

The surface soil samples contained four metals (aluminum, beryllium, iron, and vanadium) above adjusted residential soil RBCs. The groundwater samples contained four metals (arsenic, beryllium, iron, and manganese) above adjusted tap water RBCs. The beryllium concentration in well MW-DA-002 also was above the drinking water MCL of 4  $\mu\text{g/L}$ . Due to a seasonal shift in the groundwater flow patterns, monitoring well GW13W rather than MW-DA-001 is upgradient of the AREE. (Monitoring well GW13W was not sampled during the SI activities.) An additional round of groundwater sampling is recommended to include GW13W and determine the true background metals concentrations. The need for further investigation of the soils in the areas that were already sampled at the AREE should be based

**Table 3-80. Data Summary Table: Groundwater - Disposal Area (AREE 29-4)**  
**Vint Hill Farms Station, Warrenton, Virginia**

Site ID	MW-DA-001	MW-DA-002	MW-DA-003	PG-DA-001	PG-DA-002
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01
Site Type	WELL	WELL	WELL	WELL	WELL
Collection Date	6/14/95	6/14/95	6/14/95	11/16/94	11/16/94
Depth (ft)	26.12	31.15	20.1	6.67	4.94
Associated Field QC Sample - Site ID					
Associated Field QC Sample - Field Sample No.					
Associated Field QC Sample - Field Sample No.					
<b>METALS/WATER/GFAA (AX8, SD18, SD25, 7041) (ug/L)</b>					
Laboratory ID Number	UC01859	UC01848	UC01847	UB06371	UB06351
Parameter	Units	CRL			
Arsenic	ug/L	2.35	LT	2.35*	18.9**
Lead	ug/L	4.47	LT	4.47*	210**
<b>METALS/WATER/CVAA (CC8) (ug/L)</b>					
Laboratory ID Number	UC01859	UC01848	UC01847	UB06371	UB06351
Parameter	Units	CRL			
Mercury	ug/L	0.1	LT	0.1*	0.128**
<b>METALS/WATER/ICP (SS12, 8010) (ug/L)</b>					
Laboratory ID Number	UC01859	UC01848	UC01847	UB06371	UB06351
Parameter	Units	CRL			
Aluminum	ug/L	112	793*	3800*	540000**
Barium	ug/L	2.82	68*	213*	4110**
Beryllium	ug/L	1.12	1.57*	1.7*	49.9**
Calcium	ug/L	105	40900*	44200*	450000**
Cobalt	ug/L	25	25*	25*	664**
Chromium	ug/L	16.8	16.8*	16.8*	1200**
Copper	ug/L	18.8	18.8*	18.8*	1300**
Iron	ug/L	77.5	784*	188*	261**
Potassium	ug/L	1240	1620*	2810*	880000**
Magnesium	ug/L	135	5830*	1460*	21000**
Manganese	ug/L	9.67	39.6*	31700*	410000**
Sodium	ug/L	279	16600*	206*	32000**
Nickel	ug/L	32.1	32.1*	106000*	210000**
Thallium	ug/L	2.44	10*	32.1*	1030**
Vanadium	ug/L	27.6	27.6*	10*	50.8**
Zinc	ug/L	18	18*	27.6*	1160**
				18*	2930**
<b>VOLATILES/WATER/GCMS (UM21) (ug/L)</b>					
Laboratory ID Number	UC01859	UC01848	UC01847	UB06302	UB06303
Parameter	Units	CRL			
Acetone	ug/L	8	LT	8*	900**
Methylethylketone	ug/L	10	LT	10*	190**
					LT 10**

**Table 3-80. Data Summary Table: Groundwater - Disposal Area (AREE 29-4)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	MW-DA-001	MW-DA-002	MW-DA-003	PG-DA-001	PG-DA-002
Field Sample Number	SAIC01	SAIC01	SAIC01	SAIC01	SAIC01
Site Type	WELL	WELL	WELL	WELL	WELL
Collection Date	6/15/95	6/14/95	6/14/95	11/16/94	11/16/94
Depth (ft)	26.12	31.15	20.1	6.67	4.94
Associated Field QC Sample - Site ID					
Associated Field QC Sample - Field Sample No.					
Associated Field QC Sample - Site ID					
Associated Field QC Sample - Field Sample No.					
<b>POLYNUCLEAR AROMATIC HYDROCARBONS WATER (B310) (ug/L)</b>					
Laboratory ID Number	UC01859	UC01848	UC01847	N/A	UB06382
Parameter	Units CRL	Units CRL	Units CRL	Units CRL	Units CRL
Benzo(k)fluoranthene	ug/L 0.019 LT 0.0198*	LT 0.0198*	LT 0.0198*	N/A	LT 0.0193**
<b>SEMI-VOLATILES WATER/GCMS (UM29) (ug/L)</b>					
Laboratory ID Number				N/A	N/A
Parameter	Units CRL	Units CRL	Units CRL	Units CRL	Units CRL
TICs	ug/L 0 (0.0)	0 (0.0)	2 (9.0)	N/A	1 (6.0)

**Table 3-80. Data Summary Table: Groundwater - Disposal Area (AREE 29-4)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	PG-DA-003	Residential Tap Water RBCs	Adjusted Tap Water RBCs
Field Sample Number	SAIC01		
Site Type	WELL		
Collection Date	11/16/94		
Depth (ft)	2.11		
Associated Field QC Sample - Site ID			
Associated Field QC Sample - Field Sample No.			
Associated Field QC Sample - Site ID			
Associated Field QC Sample - Field Sample No.			

<b>METALSWATER/GFAA (AX8, SD18, SD25, 7041) (ug/L)</b>			
Laboratory ID Number	UB06304		
Parameter	Units	CRL	
Arsenic	ug/L	2.35	15.7**
Lead	ug/L	4.47	1300**
			2.2n

<b>METALSWATER/CVAA (CC8) (ug/L)</b>			
Laboratory ID Number	UB06304		
Parameter	Units	CRL	
Mercury	ug/L	0.1	0.364**
			11

<b>METALSWATER/ICP (SS12, 6010) (ug/L)</b>			
Laboratory ID Number	UB06304		
Parameter	Units	CRL	
Aluminum	ug/L	112	550000**
Barium	ug/L	2.82	3340**
Beryllium	ug/L	1.12	62.5**
Calcium	ug/L	105	260000**
Cobalt	ug/L	25	440**
Chromium	ug/L	16.8	843**
Copper	ug/L	18.8	351**
Iron	ug/L	77.5	850000**
Potassium	ug/L	1240	32300**
Magnesium	ug/L	135	280000**
Manganese	ug/L	9.67	13000**
Sodium	ug/L	279	183000**
Nickel	ug/L	32.1	885**
Thallium	ug/L	2.44	14.4** JI
Vanadium	ug/L	27.6	969**
Zinc	ug/L	18	2510**
			2200
			36
			7400
			520
			0.016c/182n
			N/A
			2200
			180
			1500
			11000
			N/A
			N/A
			180
			N/A
			730
			2.9
			260
			11000

<b>VOLATILES/WATER/GCMS (UM21) (ug/L)</b>			
Laboratory ID Number	UB06304		
Parameter	Units	CRL	
Acetone	ug/L	8	300**
Methylethylketone	ug/L	10	10**
		LT	3700
			1900



**Table 3-80. Data Summary Table: Groundwater - Disposal Area (AREE 29-4)  
Vint Hill Farms Station, Warrenton, Virginia (Continued)**

Site ID	PG-DA-003	Residential Tap Water RBCs
Field Sample Number	SAIC01	(EPA 1996)
Site Type	WELL	
Collection Date	11/16/94	
Depth (ft)	2.11	
Associated Field QC Sample - Site ID		
Associated Field QC Sample - Field Sample No.		
Associated Field QC Sample - Site ID		
Associated Field QC Sample - Field Sample No.		
<b>POLYNUCLEAR AROMATIC HYDROCARBONS/WATER (B310) (ug/L)</b>		
Laboratory ID Number	UB06374	
Parameter	Units	CRL
Benzo(k)fluoranthene	ug/L	0.019 LT 0.0193** 0.92
<b>SEMIVOLATILES/WATER/GCMS (UM25) (ug/L)</b>		
Laboratory ID Number		
Parameter	Units	CRL
TICs	ug/L	0(0.0)

**Footnotes:**

- \* - Data collected from chemical transfer file (Phase I)
- \*\* - Data collected from USAEC Pyramid system (Phase III)
- CRL - Certified reporting limit
- ID - Identification
- N/A - Not applicable
- N/F - Analysis requested, not yet received
- QC - Quality control
- TICs - Tentatively Identified Compound: number of TICs (total value)
- Boolean Codes
- LT - Less than the certified reporting limit / method detection level
- Flagging Codes
- I - Interferences in sample make quantitation and/or identification to be suspect.
- J - Value is estimated.

**Table 3-81. ARARs Comparison for Groundwater at AREE 29-4 - Disposal Area**  
**Vint Hill Farms Station, Warrenton, Virginia**

Chemical	Proportion exceeding	Maximum Contaminant Level Comparison					Federal Status	Regulatory Source
		Site ID	Sample ID	Sample Type	Field Sample	Sample Conc. (µg/L)	MCL (µg/L)	
Beryllium	1/3	MW-DA-002		WELL	SAIC01	5.24	4	Federal

SAIC01 - Samples collected by SAIC in November 1994  
MCL - Maximum Contaminant Level  
MCLG - Maximum Contaminant Level Goal

**Sources:**

Drinking Water Regulations and Health Advisories, EPA, February 1996, Office of Water, Washington, D.C.  
Water Quality Criteria - 56 FR 223.38418 (Nov., 1991), "Amendments to the Water Quality Standards Regulation; Compliance with CWA Section 303 (c)(2)(B); Proposed Rule" - Washington D.C.  
State Drinking Water Standards - The Bureau of National Affairs, Inc. (BNA), CD-ROMS, August 1994

on the results of the groundwater sampling. Additional soil sampling in two areas not previously sampled will be conducted concurrently with additional groundwater sampling during the RI.

### **3.6.28 Other Areas**

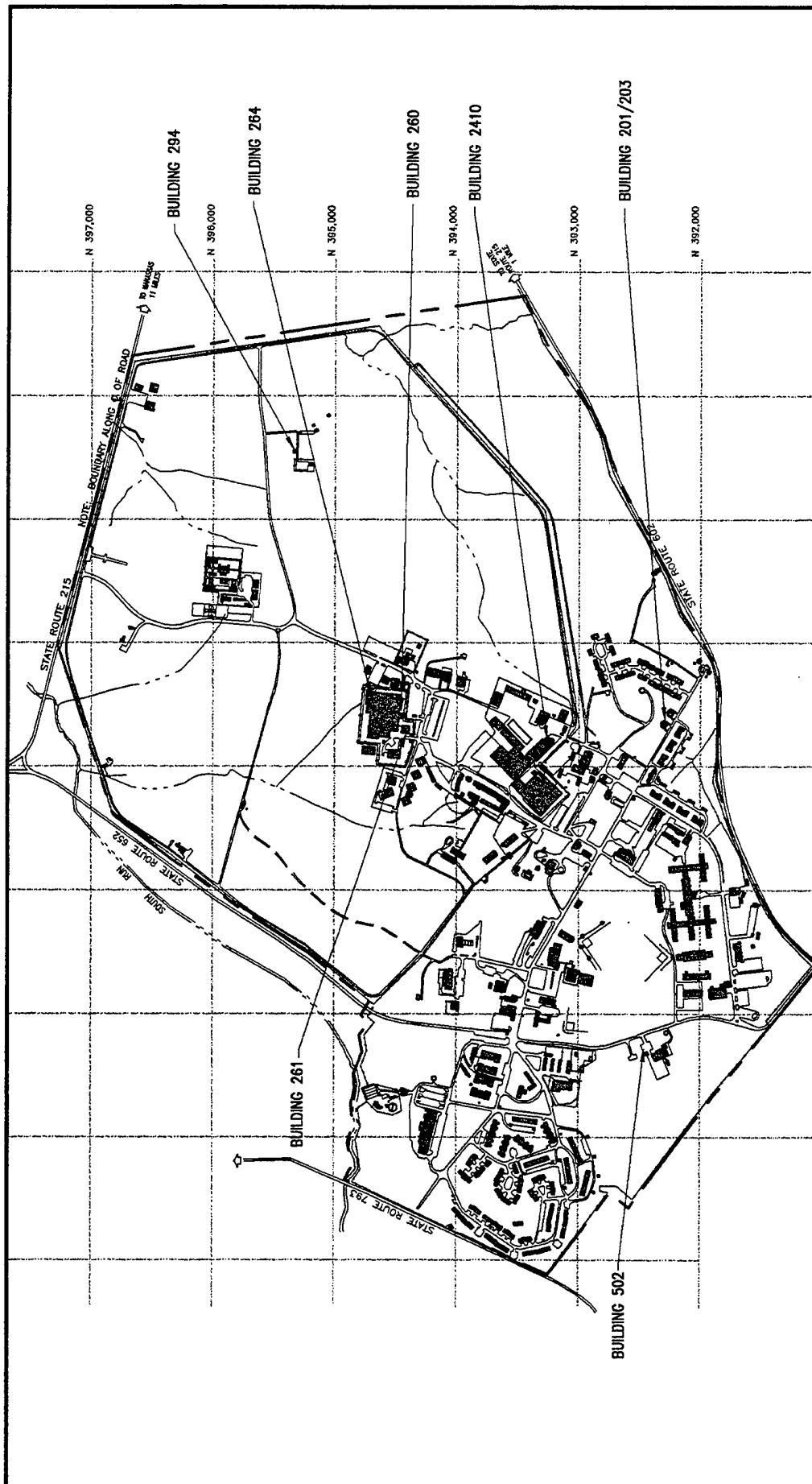
Other areas investigated at VHFS during the SI included the former pesticide and herbicide storage areas in Buildings 253 and 320 and the seven formerly leaking transformer sites. In the seven formerly leaking transformer sites, surface soil samples were collected and screened onsite for PCBs. PCBs were not detected in any of the seven samples; therefore, samples were not sent to the laboratory for analysis. Two wipe samples were taken from the walls of each of the two pesticide and herbicide storage buildings. One wipe sample from each building was analyzed for pesticides, and one was analyzed for herbicides.

#### **3.6.28.1 PCB Screening Results**

Samples were collected from the formerly leaking transformer locations near Buildings 201/203, 260, 264, 261, 294, 502, and 2410. Figure 3-45 shows the locations of these buildings. No visual evidence of former leaks was found at Buildings 260, 261, 294, 502, and 2410. A location for sample collection was chosen based on the most probable area for possible leaks to run off the transformer pad. At Building 502, the transformer and transformer pad had been removed, so a sample was taken from a location in the general area where the transformer and pad may have been located. At Building 264, a leak was visible on the west side of the transformer; therefore, the sample was collected from the soil on the west side of the transformer pad. At Building 201/203, the transformer pad contained an oily residue visible on the east side; a sample was collected from the soil adjacent to the east side of the pad. All soil samples were tested with the PCB field screening test kit. None of the seven samples tested positive for PCBs above the detection limit of 1 ppm.

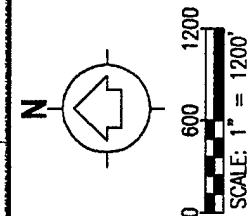
#### **3.6.28.2 Wipe Sample Results**

Wipe samples were collected from the walls of Buildings 253 and 320. No pesticides were detected on the wipes from either of these buildings. The herbicide 2-(4-chloro-2-methylphenoxy)propanoic acid (MCPP) was detected in samples from both buildings. MCPP was



**LEGEND:**

- BUILDING
- FENCE
- SITE BOUNDARY
- PAVED ROAD
- STREAM



Science Applications International Corporation  
**VINT HILL FARMS STATION**  
**WARRENTON, VIRGINIA**  
**SI REPORT**

**PCB SCREENING LOCATIONS**

Figure:	Project:	Date:
3-45	01-0827-03-6521-065 / 95005/DWGS/400SITE	05-13-98

detected at 640  $\mu\text{g}$  on the wipe from Building 253. The wipe from Building 320 contained 300  $\mu\text{g}$  of MCP.

#### **3.6.28.3 PCB Screening Site Assessment**

No soil samples tested positive for PCBs at the seven formerly leaking transformer locations. No evidence exists to indicate that the prior spills were not properly remediated; therefore, no further actions are recommended at these sites.

#### **3.6.28.4 Wipe Sample Site Assessment**

The herbicide detected at both buildings was MCP. MCP is a systemic hormone type phenoxy-herbicide used for selective control of broadleaf weeds, such as clover, dandelion, and chickweed. The results from the wipe samples indicate that previous storage of this herbicide in the buildings has left residual contamination on the walls. Based on the reuse decision for these buildings, decontamination may be necessary.

## 4. CONCLUSIONS AND RECOMMENDATIONS

Site Inspection (SI) activities were conducted at 27 areas requiring environmental evaluation (AREEs) at Vint Hill Farms Station (VHFS). The purpose of the SI was to identify the presence and nature of potential environmental contamination at the AREEs. This section summarizes the conclusions and recommendations made based on the findings of the SI activities.

### 4.1 SITE CONDITIONS

Descriptive soils information was obtained at 22 AREEs and a background location where soil samples were collected. At 15 of these AREEs, soil borings were drilled and information was gathered that included lithologic logging of the boreholes and geotechnical analysis of the soil samples. Hydrogeologic characterization at VHFS consisted of measuring groundwater elevations at 14 existing monitoring wells and 15 installed monitoring wells and determining groundwater flow directions at the facility. Complete geologic and hydrogeologic characterization of the AREEs investigated during the SI was not an objective of the field program.

The subsurface conditions encountered during the SI drilling activities were consistent with previously documented findings. Bedrock is present at depths ranging from approximately 4 feet below land surface (BLS) in the north central portion of VHFS to approximately 23 feet BLS in the south central portion of the facility. The overburden identified is predominantly a residuum alluvial material consisting of silts, clays, and gravels.

The groundwater system in the area of VHFS is a single aquifer system that consists of upper and lower units. The upper portion of the aquifer is located in unconsolidated overburden material and weathered, decomposed bedrock and ranges in depth from land surface to approximately 60 feet BLS. No confining layers were identified in the upper portion of the aquifer or at the overburden/bedrock interface. The shallow portion of the aquifer at VHFS has been the focus of the environmental investigations conducted at VHFS.

Groundwater in the western and central portions of the facility generally flows to the north-northwest; groundwater in the eastern portion of the facility flows to the east and northeast. Previous hydrogeologic investigations suggest that a groundwater divide or mound exists in the northeastern portion of VHFS.

An assessment of the environmental setting shows that media susceptible to contamination from past and present operations at VHFS include soils, groundwater, surface water, and sediments. Contaminant migration to the shallow aquifer is likely, particularly in areas where the water table is protected only by a relatively thin surficial silt and clay layer. Vertical migration of contaminants also can occur through fractures in the bedrock. Where groundwater discharges to intermittent streams and the South Run tributaries, contaminant migration to surface water and sediments is also a threat.

#### **4.2 DATA QUALITY ASSESSMENT**

A comprehensive quality assurance/quality control (QA/QC) program was followed during the SI conducted at VHFS to ensure that analytical results were representative of the environmental conditions at the AREEs. In general, these procedures and control data indicate that the chemical data accurately represent the sampling locations from which they were collected. All data quality objectives (DQOs) for the project were met. A few compounds were found to be suspect in specific samples and were considered potential false positives. The presence of these compounds did not affect the usefulness of the environmental data and was noted where appropriate.

#### **4.3 STREAMLINED RISK ASSESSMENT**

A streamlined risk assessment was conducted for 12 AREEs at VHFS to support the no further action (NFA) decisions. In accordance with VDEQ guidance (VDEQ 1995), the streamlined risk assessment used the maximum detected concentration at each AREE as the exposure point concentration and evaluated exposures from soil and groundwater ingestion under both current and future land uses. Under current land use, station workers and construction workers were the receptors at risk of exposure. Under future land use, residents (children and adults) were the receptors at risk of exposure.

The results of the streamlined risk assessment are summarized in Table 4-1. The risk estimates calculated for each chemical in each AREE are presented in Appendix M. Under current industrial land use, noncancer hazard indexes (HIs) do not exceed the target of 1 and cancer risks do not exceed the target of  $1 \times 10^{-4}$  for either the station worker or the construction worker. Under future residential land use, noncancer HIs exceed the target of 1 at AREEs 2, 5 (soil only), and 7. Cancer risks do not exceed the target of  $1 \times 10^{-4}$ . The most prevalent chemicals of concern for noncancer effects are manganese and vanadium.

When interpreting the results of the risk assessment, several factors should be considered. Most importantly, the risk estimates have been based on the maximum detected values. The risks based on the maximum concentrations are very likely to be overestimates. Another important point is that no risk targets were exceeded under current land use, and were exceeded only under hypothetical residential land use. As defined in the most recent land reuse plan, the AREEs under investigation are not likely to be developed for residential purposes. The magnitude of the risks are low, and there are only a few marginal cases where HIs exceed 1. None of the HIs appreciably exceed 1, and this finding is supported by the fact that HIs exceed 1 only for the resident child; none of the HIs for the resident adult exceed 1. The highest HI for an adult is 0.3 at AREE 5. If the HIs had exceeded one for both the child and adult, the evidence would have been much more substantial that the potential for adverse health effects exists if the property was developed for residential purposes.

Much of the risk as presented is attributable to the toxic effects of naturally occurring metals. The concentration of the metals varies over about an order of magnitude from AREE to AREE. This same degree of variability also is reflected in the risk estimates, since the risks are dominated by the naturally occurring metals. The regional soil data show that an order of magnitude range of concentration is not unusual for metals in uncontaminated soil. There is no apparent pattern to where the maximum detected concentration of metals was found (i.e., the maximum concentrations of different metals were found at AREEs 2, 5, 7, 10, 13, 18, 20, 21, and 26). Clearly, further investigation and remedial actions are not warranted by natural concentrations of metals, even if the risks slightly exceed targets. Although three of the AREEs have HIs that are greater than 1 (in particular AREEs 2, 5, and 7), the existing weight of



**Table 4-1. RME Risk Characterization Summary**  
**Vint Hill Farms Station, Warrenton, Virginia**

Medium	Exposure Route and Location	Current Land Use						Future Land Use									
		Noncancer HI			Cancer Risk			Noncancer HI			Cancer Risk						
		Station Worker	Construction Worker	Station Worker	Construction Worker	Resident Child	Resident Adult	Resident Child	Resident Adult	Resident Child	Resident Adult						
Soil	Soil Ingestion	0.1	B	0.7	B	5E-06	B	3E-06	B	2	E	0.2	B	2E-05	E	9E-06	E
		0.2	B	1	B	1E-05	B	7E-06	B	3	E	0.3	B	4E-05	E	2E-05	E
		0.1	B	0.6	B	2E-06	B	9E-07	B	2	E	0.2	B	5E-06	E	3E-06	E
		0.07	B	0.3	B	2E-06	B	1E-06	B	0.9	B	0.1	B	6E-06	E	3E-06	E
		NA		NA		NA		NA		NA		NA		NA		NA	
		0.08	B	0.4	B	3E-06	B	1E-06	B	1	B	0.1	B	8E-06	E	4E-06	E
		0.06	B	0.3	B	2E-06	B	1E-06	B	0.7	B	0.08	B	7E-06	E	4E-06	E
		0.1	B	0.5	B	5E-06	B	3E-06	B	1	B	0.1	B	1E-05	E	8E-06	E
		0.1	B	0.4	B	2E-06	B	1E-06	B	1	B	0.1	B	6E-06	E	3E-06	E
		0.1	B	0.5	B	4E-06	B	2E-06	B	1	B	0.1	B	1E-05	E	6E-06	E
		0.07	B	0.4	B	4E-06	B	2E-06	B	1	B	0.1	B	1E-05	E	7E-06	E
		0.03	B	0.1	B	1E-06	B	7E-07	B	0.3	B	0.04	B	4E-06	E	2E-06	E
		0.04	B	0.2	B	2E-06	B	1E-06	B	0.5	B	0.05	B	6E-06	E	3E-06	E
		Groundwater	Groundwater Ingestion	NA		NA		NA		NA		0.2	B	0.09	B	7E-07	B
AREE 5																	

NA - pathway not evaluated

Results are likely to be conservative overestimates, for several reasons:

Maximum concentrations were used as the exposure point concentrations.

Sampling was purposive; biased toward representing small areas within which activities were known or reported to be concentrated.

Child and adult resident risks were calculated separately. HIs for an integrated child(6 years)/adult(24 years) receptor would be lower than shown for the child; the greatest would be 0.9 at AREE 5.

B - HI  $\leq 1$  or ELCR  $\leq 10^{-6}$  for the residential scenario; HI  $\leq 1$  or ELCR  $\leq 10^{-4}$  for the worker scenarios

E - HI  $> 1$  or ELCR  $> 10^{-6}$  for the residential scenario; HI  $> 1$  or ELCR  $> 10^{-4}$  for the worker scenarios

evidence does not suggest that there is a discernible pattern of contamination that warrants either additional investigation or remediation.

#### **4.4 AREE-SPECIFIC CONCLUSIONS AND RECOMMENDATIONS**

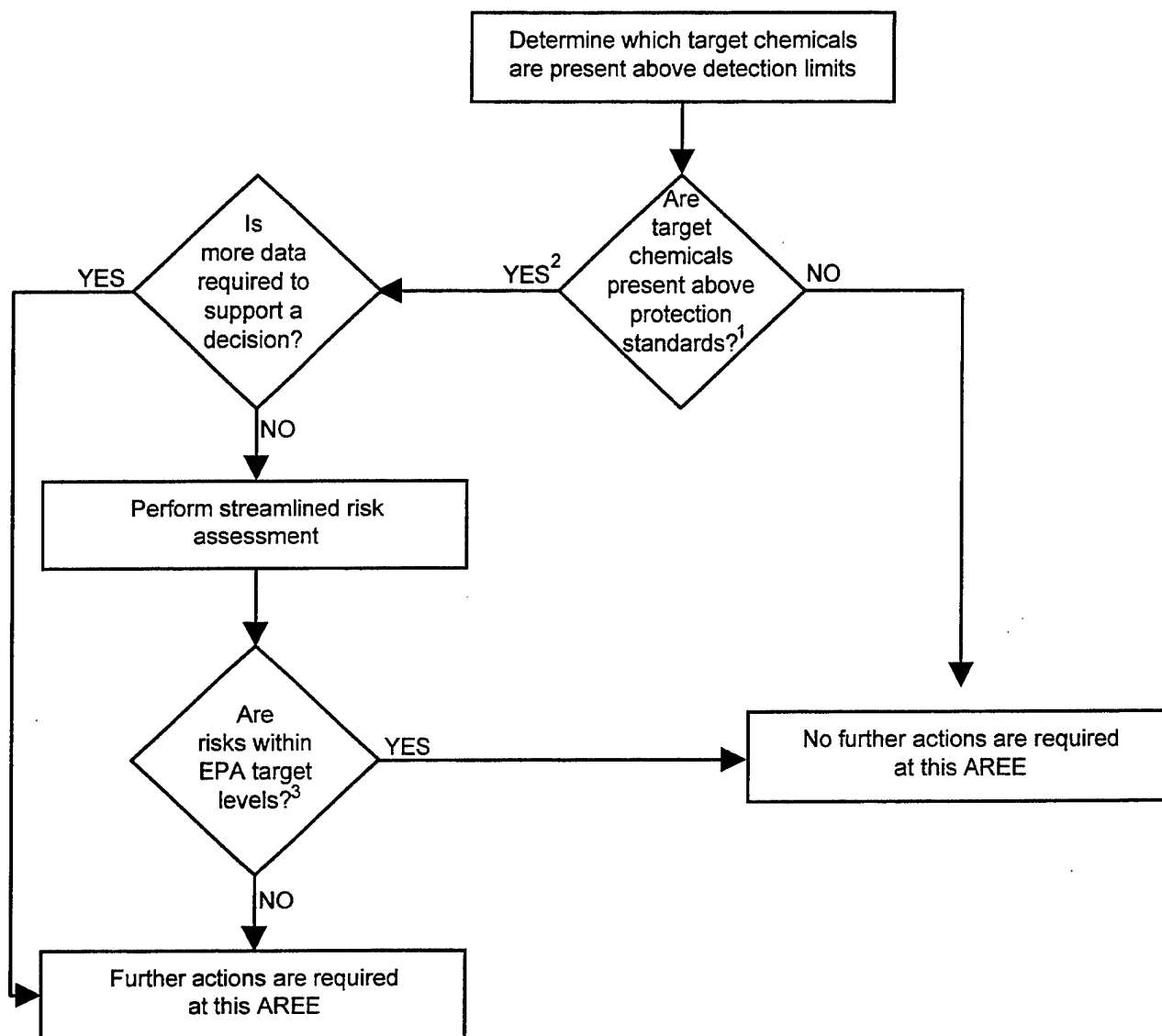
The SI sampling program was designed to determine the presence or absence of contamination in areas where past and present operations may have affected environmental media. Sampling locations were, in general, biased toward the most probable areas of contamination. The sampling program was not intended to determine the full extent of contamination at the AREEs. There were no indications that contamination at any of the AREEs would present an imminent danger such that immediate response action would be required.

The environmental data and analytical results were evaluated to determine the importance of detected concentrations of target compounds. The decision process used to determine if further action is necessary is provided in Figure 4-1. Recommendations were made for further action based on the quality of the environmental data, presence of target compounds at concentrations above protection standards, results of the streamlined risk assessment (if applicable), and past site history. Concentrations of inorganic analytes present at the AREEs were compared to background and regional concentrations. However, no decisions for further action were made based on the background and regional comparisons. The AREE-specific conclusions and recommendations are summarized in Table 4-2. Regulatory requests for additional sampling and analysis, which were made outside of the decision process outlined in Figure 4-1, also are included in the table.

No further action is recommended and the U.S. Environmental Protection Agency (EPA) has not requested further characterization at the following three AREEs:

- Electrical Equipment Facility Pretreatment Tank (AREE 7)
- Incinerator (AREE 20)
- Transformer Storage Area (AREE 24).

Figure 4-1. Determination of Further Actions for AREEs  
Vint Hill Farms Station, Warrenton, Virginia



<sup>1</sup> Relevant protection standards are as follows: EPA Region III residential soil RBCs for surface and subsurface soils; NOAA ER-L concentrations for sediments; EPA Region III tap water RBCs or federal drinking water MCLs for groundwater (whichever is most stringent); and EPA Region III tap water RBCs or federal ambient water quality criteria for surface water (whichever is most stringent).

<sup>2</sup> A statistical background comparison was performed for target chemicals detected above protection standards in the soils. However, no decisions for further action were made based on the background comparisons.

<sup>3</sup> EPA target levels are a hazard index of less than 1 and a cancer risk of less than  $10^4$ .

**Table 4-2. Summary of Conclusions and Recommendations for the AREEs  
Vint Hill Farms Station, Warrenton, Virginia**

AREE No.	AREE Name	Conclusions	Recommendations
1	Dump #1	Metals, SVOCs, TPH, and pesticides were present in the surface water and groundwater; VOCs were present in the soil gas.	Quantify soil contamination at the dump and determine the extent of groundwater and surface water contamination.
2	Sewage Treatment Plant	Target compounds were not detected above protection standards in the surface soils downgradient from the drying beds with the exception of arsenic and beryllium, which are within their background or regional ranges. Streamlined risk assessment shows risks do not exceed EPA target levels under current land use, but exceed target levels under a residential land use scenario.	No further action is recommended. However, EPA has requested additional sampling to further characterize this AREE.
3	Warehouse	Metals and TPH were present in the soils beneath the hydraulic lifts. SVOCs were detected in the soils at the drain outlet.	Further investigation of the soils beneath the hydraulic lifts and at the drain outlet. Confirm the presence or absence of contamination beneath the grease pit.
4	Auto Craft Shop	Metals, SVOCs, and TPH were present in the soils at the runoff points.	Characterize the extent of soil contamination at the runoff points.
5	EPIC Building	Cracks and pipe offsets were identified and located in the sewerline. Pentachlorophenol was detected in the duplicate groundwater sample, but not in the primary groundwater sample, and therefore, is considered suspect. Streamlined risk assessment shows risks do not exceed EPA target levels under current land use, but exceed target levels under a residential land use scenario.	No further action is recommended for the soils. However, EPA has requested additional sampling to further characterize the soils surrounding the sewerline. An additional round of groundwater sampling at GW06W is recommended to confirm the presence of pentachlorophenol. Sampling of pipeline effluent also is recommended. If results indicate contamination, the sewerline should be properly abandoned.
7	Electrical Equipment Facility Pretreatment Tank	Target compounds were not detected above protection standards and background levels in the soils near the bottom of the neutralization pit. Streamlined risk assessment shows risks do not exceed EPA target levels under current land use, but exceed target levels under a residential land use scenario.	No further action is recommended. However, additional actions may be necessary to complete the RCRA closure for this AREE.

**Table 4-2. Summary of Conclusions and Recommendations for the AREEs  
Vint Hill Farms Station, Warrenton, Virginia (continued)**

AREE No.	AREE Name	Conclusions	Recommendations
9	Vehicle Maintenance Area	Metals, VOCs, SVOCs, TPH, and pesticides were present in the soils beneath the neutralization pit and in the surface water and sediments of the western South Run tributary at the stormwater outlet.	Characterize the full extent of contamination in the soils beneath the neutralization pit and in the western South Run tributary.
10	Former Photographic Wastewater Lagoon	Target compounds were not detected above protection standards and background concentrations in the soils from the former lagoon bottom. Streamlined risk assessment shows that risks do not exceed target levels from soil ingestion. Metals were present in groundwater above MCLs.	Investigate the source of groundwater contamination. No further action is recommended for the soils. However, the EPA has requested additional sampling to further characterize this AREE.
11	Former Sewage Treatment Plant	Metals and SVOCs were present in the surface soils at the former drying bed and sludge pile locations.	Characterize the full extent of contamination in the soils and determine if contamination exists in the adjacent tributary.
12	Dump #2	Target compounds were not detected above protection standards and background concentrations in the groundwater with the exception of beryllium, which is below the drinking water MCL. Streamlined risk assessment shows that risks of groundwater ingestion do not exceed EPA target levels.	No further actions is recommended. However, EPA has requested additional sampling to further characterize this AREE.
13	Sludge Disposal Area	Target compounds were not detected above protection standards and background concentrations in the soils with the exception of aluminum and iron. Streamlined risk assessment shows that risks of soil ingestion do not exceed EPA target levels.	No further action is recommended. However, EPA has requested additional sampling to further characterize this AREE.
14	Skeet Range	Elevated concentrations of lead were present in the surface soils of the range, although soil quality parameters indicate that the lead has a low mobility.	Further investigations to determine the extent of lead contamination in the soils, the potential for lead migration to the groundwater, and the need for remedial action.
16	Firefighter Training Pit	Metals and TPH were present in the surface soils. Precise location of the pit was not established.	Further soil investigation to determine the correct pit location.

**Table 4-2. Summary of Conclusions and Recommendations for the AREEs  
Vint Hill Farms Station, Warrenton, Virginia (continued)**

AREE No.	AREE Name	Conclusions	Recommendations
17	Dump #3	Metals, SVOCs, phenols, and VOCs were detected in the groundwater downgradient from the dump.	Systematic soil sampling within the dump to determine if the soils are the source of the contaminants. An additional round of groundwater sampling using filtered samples also is recommended to determine which metals are above background.
18	Grease Pit	Target compounds were not detected above protection standards in the soils from the pit bottom with the exception of beryllium and iron, which were within background concentrations. Actual location of the pit may not have been established.	Further subsurface investigations in the area now believed to be the correct location of AREE 18.
19	Pistol Range	Elevated concentrations of lead were present in the surface soils and drainage ditch leading to the western South Run tributary.	Further investigation of the subsurface soils, drainage ditch sediments, and tributary surface water is warranted to determine the extent of contamination.
20	Incinerator	Target compounds were not detected above protection standards in the soils from the leach field with the exception of beryllium, aluminum, and iron, which were within background concentrations. Streamlined risk assessment results show that soil ingestion risks do not exceed EPA target levels.	No further action.
21	Sand Filter Beds	Target compounds were not detected above protection standards in the soils inside or outside the filter beds with the exception of arsenic, aluminum, beryllium, iron, and vanadium, which were within their background or regional ranges. Streamlined risk assessment results show that soil ingestion risks do not exceed EPA target levels. Arsenic, beryllium, iron, and manganese were detected above protection standards in the groundwater.	No further investigation of the soils near the filter beds is required. Soil sampling within the absorption field is recommended to determine if this area is the source of the elevated metals concentrations in the groundwater. An additional round of groundwater sampling also is recommended.

**Table 4-2. Summary of Conclusions and Recommendations for the AREEs  
Vint Hill Farms Station, Warrenton, Virginia (continued)**

AREE No.	AREE Name	Conclusions	Recommendations
24	Transformer Storage Area	Target compounds were not detected above protection standards in the surface soils around the area, with the exception of arsenic, aluminum, beryllium, iron, and vanadium, which were within their background or regional ranges. Streamlined risk assessment results show that soil ingestion risks do not exceed EPA target levels.	No further action.
25	Sugar Tree	One localized area of petroleum contamination in the soil was detected. The potential for migration is minimal given the low-permeability soils, biodegradability of the compounds detected, and minimal extent.	No further action is recommended. However, EPA has requested additional soil samples and a groundwater sample to further characterize this AREE.
26	Outdoor Wash Racks	Target compounds were not detected above protection standards and background concentrations in the soils downgradient from the former or current wash rack locations with the exception of arsenic at the current wash rack location, which was within regional concentrations. SVOCs and TPH were present at the current location at concentrations well below protection standards. Streamlined risk assessment results for both the former and current locations show that soil ingestion risks do not exceed EPA target levels.	No further investigation of the soils is required at the former or current wash rack locations. Implement pollution abatement measures for continued use of the current wash rack.
27	AAFES Service Station	Metals, SVOCs, and TPH were present in the surface soils at the outlet of the grit chamber and the surface runoff point.	Further investigation to determine the full extent of soil contamination and the need for remediation of the soils.
28-5	Former Service Station Abandoned USTs	VOCs, SVOCs, lead, and TPH were present in the subsurface soils near the abandoned USTs and beneath the former pump island.	Characterize the shallow groundwater downgradient from the AREE and soil in the vicinity of the distribution lines and pump islands.
29-1	Salvage Yard	No buried drums or non-inert debris were seen in the test pits.	No further action is recommended. However, due to EPA concerns, a soil sample will be collected and analyzed during RI activities.

**Table 4-2. Summary of Conclusions and Recommendations for the AREEs**  
**Vint Hill Farms Station, Warrenton, Virginia (continued)**

AREE No.	AREE Name	Conclusions	Recommendations
29-2	Possible Sludge Disposal Area	Target compounds were not detected above protection standards in the surface soils with the exception of beryllium and iron, which were within background concentrations. Streamlined risk assessment results show that soil ingestion risks do not exceed EPA target levels. Beryllium, manganese, and chloromethane exceeded tap water RBCs, but were below drinking water MCLs.	No further investigation of the soils is recommended. However, at the request of EPA, soil samples will be collected during the RI for additional parameters to further characterize the site. An additional round of groundwater sampling is recommended.
29-3	Possible Disposal Area	Geophysical survey results are inconclusive.	Test pits in the areas of geophysical anomalies.
29-4	Disposal Area	Metals were present in the surface soils and groundwater.	An additional round of groundwater sampling (including GW13W) to determine if the metals in the groundwater are above background. Additional soil sampling in two areas not previously sampled will be conducted during the RI.
-	Other Areas - PCB Screening	No PCBs were detected.	No further action.
	Other Areas - Wipe Samples	MCCP detected on walls of both buildings.	Further action should be based on the building reuse decisions.

MCL - Maximum Contaminant Level  
MCCP - 2-(4-chloro-2-methylphenoxy)propanoic acid  
PCB - Polychlorinated Biphenyl  
RBC - Risk-based Concentration  
RI - Remedial Investigation  
TPH - Total Petroleum Hydrocarbons  
SVOC - Semivolatile Organic Compound  
VOC - Volatile Organic Compound



No further action is recommended at these three AREEs based on the results that show target compounds were not present at concentrations greater than the protection standards and background concentrations. Any additional actions that may be required for the Electrical Equipment Facility Pretreatment Tank (AREE 7) will be addressed under the ongoing Resource Conservation and Recovery Act (RCRA) closure.

Based on the results of the streamlined risk assessment, no further action also is recommended at the following AREEs:

- Sewage Treatment Plant (AREE 2)
- EPIC Building (AREE 5)
- Soils at the Former Photographic Wastewater Lagoon (AREE 10)
- Dump #2 (AREE 12)
- Sludge Disposal Area (AREE 13)
- Soils at the Sand Filter Beds (AREE 21)
- Soils at the Possible Sewage Disposal Area (AREE 29-2).

However, EPA believes that additional sampling is necessary to further characterize these AREEs.

One localized area of diesel fuel contamination was detected in the soil at Sugar Tree (AREE 25). No further action is recommended for this AREE because the potential for migration is minimal given the low permeability of the soils, the biodegradability of the compounds detected, and the limited extent of hydrocarbons detected. However, EPA has requested additional soil samples and a groundwater sample to further characterize this AREE.

No further action is recommended at the Salvage Yard (AREE 29-1) because results from the excavated test pits revealed only inert debris that would not impact the soils at this AREE. However, EPA has requested a soil sample be collected and analyzed to confirm that contamination is not present in the location of the inert debris.

Further investigation activities are recommended for the following nine AREEs where the analytical results exceed the protection standards and background concentrations (where available) for the VHFS project:

- Dump #1 (AREE 1)
- Warehouse (AREE 3)
- Auto Craft Shop (AREE 4)
- Vehicle Maintenance Area (AREE 9)
- Former Sewage Treatment Plant (AREE 11)
- Skeet Range (AREE 14)
- Dump #3 (AREE 17)
- Pistol Range (AREE 19)
- Army, Air Force Exchange Service Station (AREE 27).

Additional investigation of the soil and/or groundwater is recommended at these AREEs to determine the full extent of contamination. Further investigation activities also are recommended for the Possible Disposal Area (AREE 29-3) based on anomalies detected as a result of the geophysical survey conducted in this area.

Further investigations are recommended for the soils at the Firefighter Training Pit (AREE 16) and the Grease Pit (AREE 18) due to uncertainties regarding their locations. Additional soil investigations are recommended at the Former Service Station Abandoned Underground Storage Tanks (USTs) (AREE 28-5) to determine if areas of contamination exist in the soils above the USTs near the distribution lines and former pump island. A groundwater investigation also is recommended at this AREE because the potential impact to groundwater is unknown.

An additional round of groundwater sampling is recommended at four AREEs to confirm the presence of contamination:

- Former Photographic Wastewater Lagoon (AREE 10)
- Sand Filter Beds (AREE 21)
- Possible Sludge Disposal Area (AREE 29-2)
- Disposal Area (AREE 29-4).

If contamination is confirmed, further investigation activities will be necessary to determine the source of contamination. Additional soil sampling will be conducted at the Disposal Area (AREE 29-4) during the RI in two areas not previously sampled.

No further soil or groundwater investigation activities are recommended at the Outdoor Wash Racks (AREE 26). However, it is recommended that more stringent pollution abatement measures be implemented at the current Outdoor Wash Racks.

Polychlorinated biphenyl (PCB) screening conducted at seven formerly leaking transformer locations showed no evidence of PCBs. Therefore, no further actions are recommended for these sites.

Results from wipe samples collected from the interior walls of two buildings (Buildings 253 and 320) indicate that previous storage of herbicides in the buildings has left residual contamination on the walls. Based on the reuse decision for these buildings, decontamination may be necessary.

The groundwater sample collected from GW01W contained metals, total petroleum hydrocarbons (TPH), phenols, and pesticides above protection standards. Due to this contamination, the well could not be used to determine background groundwater concentrations. Further investigation is recommended to determine the source of the contamination.

A facility-wide stream assessment also is recommended to determine the condition of South Run and its three tributaries. Surface water and sediment samples should be collected upstream and downstream, from potential source areas identified in this report. The environmental health of South Run is important because this stream discharges into Lake Manassas, a public water supply source.

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